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ABSTRACT

This document contains the transcript of three hearings on the High Speed Performance Computing and High Speed Networking Applications Act of 1993 (H.R. 1757). The hearings were designed to obtain specific suggestions for improvements to the legislation and alternative or additional application areas that should be pursued. Testimony and prepared statements were received from: (1) John H. Gibbons, Office of Science and Technology Policy; (2) Thomas J. Tauke, NYNEX; (3) Robert H. Ewald, Cray Research; (4) W. B. Barker, BBN Communications; (5) Richard F. Rashid, Microsoft; (6) Major R. Owens, House Subcommittee on Select Education and Civil Rights; (7) Don E. Detmer, University of Virginia; (8) Connie Stout, Texas Educational Network; (9) John Masten, New York Public Library; (10) Martin A. Massengale, University of Nebraska; (11) Cynthia H. Braddon, Information Industry Association; (12) Donald A. B. Lindberg, National Coordination Office for HPCC Program; (13) Malvin H. Kalos, Cornell Theory Center; (14) Jeffrey C. Kalb, Maspar Computer Corp.; (15) Edward Masi, Intel; (16) Fred Weingarten, Computing Research Association; (17) David K. Herron, Lilly Research Laboratories; and (18) John B. Gage, Sun Microsystems Laboratories. Subcommittee and committee markups of H.R. 1757, as well as prepared statements from the Consortium for International Earth Science Information Network, International Society for Technology in Education, Coalition for Patent Information Dissemination, and Microcomputer Industry Association, are appended. (KRN)

ED 365 282

H.R. 1757—HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993

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HEARINGS

BEFORE THE

SUBCOMMITTEE ON SCIENCE

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

APRIL 27; MAY 4, 11, 1993

[No. 37]

Printed for the use of the
Committee on Science, Space, and Technology

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H.R. 1757—HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993

TUESDAY, APRIL 27, 1993

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 9:36 a.m., in room 2318, Rayburn House Office Building, Hon. Rick Boucher (Chairman of the Subcommittee) presiding.

Mr. BOUCHER. The subcommittee will come to order.

This morning the Subcommittee on Science will receive testimony on the High Performance Computing and High Speed Networking Act of 1993, H.R. 1757. The bill authorizes research, development, and demonstration of high speed networking technologies, which are essential activities to achieve the Administration's goal of information superhighways for the Nation.

It also conforms to the information infrastructure provisions contained in the President's technology plan entitled, "Technology for America's Economic Growth." That was released by the President on February 22.

I introduced H.R. 1757 last Wednesday, and am very pleased to be joined in the co-sponsorship of the measure by the Ranking Republican Member of the Subcommittee, the gentleman from New York, Sherry Boehlert, and by the Chairman of the Full Committee on Science, Space, and Technology, George Brown from California. I would also like to acknowledge additional co-sponsorship by Members of this Subcommittee: Mr. Valentine, Mr. Barcia, Ms. Eshoo, and Ms. Eddie Bernice Johnson.

The bill was developed following this subcommittee's hearing on February 2, and it reflects many of the recommendations and suggestions that were expressed by witnesses at that time. I would like to pay particular tribute today to the vision of Vice President Gore, who for more than a decade, has been advancing the deployment in this Nation of the world's most capable interactive telecommunications network. His vision led to the enactment of the High Performance Computing Act of 1991 and contributed significantly to the early thinking that is the foundation for the measure which is the subject of today's hearing.

In order to capture the promise of the High Performance Computing Act of 1991, our bill targets the following research goals for applications of the high speed network. First, the National Science

Foundation will be required to establish a program to connect institutions of higher education, elementary and secondary schools, and local governments to each other and to the Internet with a broad band capability. The hardware and the broad band connections that are necessary to establish those connections may be provided directly by the National Science Foundation.

Within one year, we require a report on the extent to which schools, libraries, and state and local governments are connected to the Internet with an indication of the quality of those connections. In other words, we're interested in knowing which of the connections are of copper wires and which constitute broad band capability. We're also requiring an estimate in that report of the cost of establishing universal broad band connections for those institutions.

The second targeted application is in the field of education, with a particular emphasis on distance learning and electronic classrooms. Our goal is to facilitate the creation of a fully interactive network that will link all schools in the Nation, so that the best instruction that is available anywhere in the Nation is available everywhere in the Nation. Our provision authorizes funding for the means of accessing digital databases for educational purposes and providing in-service training for teachers in the use of advanced networking technologies.

Of particular timeliness is our targeted application of the network for health care purposes. The bill directs the National Institutes of Health, the Centers for Disease Control, and the National Library of Medicine to implement this portion of the statute. Our goal is to establish test bed networks linking hospitals, doctors' offices, medical schools, medical libraries, and universities to enable health care providers and researchers alike to share medical images and to develop computer-based patient records.

The bill also targets the development of software and visualization technology for visualizing the human anatomy and analyzing diagnostic images and records. Also authorized is research funding for virtual reality technology for simulated surgical and other medical procedures and collaborative technology that will allow a number of health care providers in remote locations around the country simultaneously to analyze patient diagnostic exams, make recommendations, and, if necessary, require that further tests be provided at that point with regard to a patient that would be situated in an examining room at some other location in the Nation. Other medical applications will include the digitizing and storage for ready retrieval of medical literature and of patient records.

The creation of digital libraries of electronic information is a fourth important application. We're seeking the development of common standards for the storage and retrieval of data in digital form, improvements in high speed scanning for the transfer of data from printed material to electronic storage, and creation of software to search and summarize large volumes of text, pictures, and sound.

The goal is for every individual in his or her home or office to have ready access to any library in the Nation, to utilize an electronic index, retrieve a particular document, and then have that document printed out on his or her laser printer, all within a matter of minutes. To achieve that goal, the statute contemplates the creation of prototype digital libraries that will serve as test beds for the systems, software, standards, and methods that will enable them to reach that result.

Finally, the legislation provides funding to facilitate the storage in digital form and for the rapid retrieval over the network of the vast stores of government information. We also create a government information locator system accessible by the Internet as a navigational aid providing citations to federal information and guidance on how that information may be obtained.

The legislation authorizes general research and development funding for computer science and engineering, computer visualization, and human cognition that is needed to make the system user friendly. It also creates a High Performance Computing and Applications Advisory Committee to be appointed by the President to recommend additional applications of the network for which federal research funding may be justified in future years.

Through the legislation, we are creating a system of periodic reports to the Congress on advances that are made in networking technology and on steps that are being taken to achieve the applications that are targeted in this bill, as well as assuring that new applications that are deserving of Federal research support are suggested and made available as information to the Congress from time to time.

H.R. 1757 also refines the definition of the National Research and Education Network first created by the High Performance Computing Act of 1991. The bill describes the network program in terms of three basic components. First, research and development of networking hardware and software required for the transmission of data at speeds of 1 gigabit per second or greater.

Secondly, experimental test bed networks that are designed to develop and to demonstrate the advanced networking technologies that result from that research and which provide connections for purposes consistent with the Act that require levels of network performance that are not currently available from private commercial network providers.

And, third, the provision of financial support that will be made directly available to researchers and educators and students to obtain access to and use of the Internet.

The bill also prohibits the use of test bed networks to provide services that could otherwise be provided satisfactorily using privately operated commercial networks, with the proviso that that restriction will take effect 18 months following the date of enactment of the bill. That delay will allow the agencies participating in the program to develop and implement a plan of direct financial support to students, educators, and researchers for research and education purposes.

This morning's hearing is the first in a series of three hearings that are designed to obtain comments and recommendations on the legislation. We are seeking specific suggestions for improvements to the bill and for alternative or additional application areas that we should consider pursuing.

We are pleased to welcome this morning Dr. John Gibbons, the President's Science Advisor and the Director of the Office on

Science and Technology Policy, who will present the administration's views on the measure. We also welcome a distinguished panel of witnesses representing the telecommunications, computer, software, and network provider industries.

Before turning to our first witness, I would like to recognize at this time the very capable Ranking Republican Member of our Subcommittee, who is a co-sponsor of this measure and whose leadership on the subject we greatly value, the gentleman from New York, Mr. Boehlert.

Mr. BOEHLERT. Thank you very much, Mr. Chairman.

I'd like to point out that two years ago Chairman Brown and I were privileged to be the original House sponsors of the first High Performance Computing Act. I point that out to demonstrate that this Committee, the Subcommittee, is proactive rather than reactive, and we do operate in the spirit of bipartisanship. That bill's primary author has now moved on to bigger things, from Senator to Vice President, but the work of shaping laws to support our emerging national information system goes on.

Chairman Boucher has done an excellent job in drafting the High Performance Computing and High Speed Networking Applications Act of 1993, and I'm happy to join him as a co-sponsor of this legislation.

The vision of a national data highway is a powerful image. If the first high performance computing bill took steps toward laying the pavement of information highways, the follow-on legislation we will take testimony on today is designed to begin to craft the rules of the road and the road maps that will allow citizens to begin to drive on those highways.

A highway without rules would be anarchy or look like the Beltway at rush hour. A national information network without standards and proven applications would be similarly chaotic. By investing in the research and development of applications for health care, education, libraries, and government information dissemination, we will take a significant stride in making the power of supercomputers accessible to the machines in our classrooms, in our offices, and in our homes.

At the core of this bill is the belief that the government can form a constructive and supportive partnership with the private sector. I am convinced that the result will be a more rapid deployment of information technologies and expanded access to the fruits of these technologies for the benefit of all mankind.

I want to thank Chairman Boucher for calling this hearing, and I wish to express a warm welcome to our distinguished witnesses from the Administration and from the industry. I read your written statements with a great deal of interest and look forward to your suggestions on how we might further improve our bill. And it's a particular pleasure to welcome our first witness, a good friend, Dr. Gibbons.

Mr. BOUCHER. Thank you very much, Mr. Boehlert.

Are there other Members of the Subcommittee who seek recognition for purposes of an opening statement? The gentlelady from Texas, Mrs. Johnson.

Ms. E.B. JOHNSON of Texas. Thank you very much, Mr. Chairman.

I simply want to say that I'm proud to join the co-sponsors with this legislation, as well as understanding and appreciate the fact that it will expand educational opportunities throughout the Nation, but especially in Texas, since it has its own education computing network called the T-Net, the Texas Education Network, which basically does the same thing as the National Research Education Network; that is, with provisions of the bill. The expansion of this provided in this bill will contribute greatly toward the improvement of our math and science curriculum.

T-NET began in August of 1991 with more than 1,800 users and is administered by the University of Texas. Noting that Dr. Norman Hackleman of the Robert E. Welsh Foundation in Houston testified earlier this year before this Committee, is working very closely with the industry to improve competitiveness as their output and human capital, 57 percent of the public-private educators or administrators or librarians and 43 percent of classroom teachers. If we are to compete internationally, we need to increase teacher participation nationwide.

And then the health care contribution, it will play an important role with the human genome project, digital imaging to further advance detection and prevention of diseases, such as, breast and colon cancer that plagues us all now. Additionally, it will cut down administrative costs by maintaining medical records electronically and allowing easy transmission of them, which makes this bill, in my judgment, worthwhile.

Thank you.

Mr. BOUCHER. Thank you very much, Ms. Johnson.

We now welcome the Director of the Office of Science and Technology Policy, the President's Science Advisor, who was former Director of the Office of Technology Assessment and served with distinction in that position for a great number of years, Dr. John Gibbons.

Dr. Gibbons, without objection, your written testimony will be made a part of the record and we would welcome your oral summary and whatever comments you care to make.

STATEMENT OF DR. JOHN H. GIBBONS, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, WASHINGTON, DC

Dr. GIBBONS. Thank you, Mr. Chairman. It's, indeed, a pleasure to appear before you this morning in my new capacity. It's a special pleasure to be back with some friends of long standing. Thank you for inviting me today and also for asking me to provide some information on the Administration's High Performance Computing and Communications Program and its important role in assisting this whole idea of the development of a National Information Infrastructure.

As you know full well, the infrastructure consists of a lot of things: computers, databanks, fax machines, telephones, video displays linked by high speed telecommunications networks that are capable of transmitting an enormous amount of information over any distance at an extraordinary speed, equivalent to the movement of an Encyclopedia Britannica in a few seconds. I'm not sure I could read it that fast, but you can move it from one place to another that fast as we move along.

This capability reflects a continuing extraordinary advance in the science and technology of semiconductors, computers, and the likes. And I think it's worthy to note that we have multiplied the rapidity with which we can move information which can be translated to lower the cost of a given amount of information by a factor of about 30 every few years, and this is almost unparalleled in the history of technology, that such rapid innovation occurs year after year after year, and the end is not in sight.

Now using these technologies, we're at the state at this point in time where, as has been mentioned, a doctor who needs a second opinion can transmit or will be able to transmit a patient's entire medical record, including high resolution x-rays and other things that require a lot of information, to a distant colleague very inexpensively in a very short period of time, and so you have a virtual collection of medical capabilities that can lend assistance to an individual doctor, however isolated that doctor might be from centers of medical learning.

In a similar sense, a school child in a small town could come home and with a personal computer reach right into the Library of Congress and explore the wonderful assets that are there by virtue of the taxes that that student's parents are paying. And at home viewers can choose what they want to watch, when they want to watch it, rather than taking a random chance.

And, as you know, the Administration is committed to accelerating the development of this infrastructure that we need so much, I believe, in the coming century. The infrastructure will provide us—that is, the American people—with the information that they need when they need it, whether it be in text, sound, video, or images. These so-called superhighways will certainly continue to revolutionize the way we work and learn and shop and live. That revolution, as we all know, is already underway, but we foresee a rapid escalation of that revolution in the coming decades.

The infrastructure will be as ubiquitous as the telephone system that we so much take for granted now, but it will be able to carry information at least a thousand times greater than the telephone itself can do now. It will transit not only our voice and the ubiquitous fax machine, but will also provide hundreds of channels of interactive high definition television-type signals, teleconferencing, and access to huge databases. In fact, the opportunities that this expansion of capability provide us enable us to see through a glass somewhat dimly about how this extraordinary new capability is going to actually take place in our lives, and I think that's another reason to underscore that we, the people, through government have an opportunity to explore, to experiment, to understand how we can take full advantage of this extraordinary development.

The technology is, obviously, already at use in many of our research laboratories where it continues to transform the way research is not only carried out, but even the way one conceives and conceptualizes problems. It allows scientists and engineers to access information from computer databases scattered all over the country and, indeed, the world. It enables them to use supercomputers and research equipment literally thousands of miles away from their desks. And perhaps most importantly, it enables researchers to collaborate with their colleagues around the country and around the world almost as easily as if they were in the same building.

And, obviously, this has already spilled out into the commercial and industrial sector. Automatic teller machines and other electronic funds transfer devices are taken for granted these days. They are early spillouts and spillovers of these technologies developed by public investments.

I've seen the same sort of technologies being used in the automotive industry to model new automobiles or to simulate crashworthiness. And, obviously, it is a very essential part of our defense capabilities these days.

Now this same telecommunications and computing technology could be available to all Americans in the very near future provided there is an adequate public and private investment and a forward-looking government policy set that promotes its deployment and use, and that speaks to the bill that this committee has created.

The Clinton Administration believes, Mr. Chairman, that the Federal Government has several very important roles to play in assisting the development of this information infrastructure. It will be—as we all understand I hope now, the infrastructure itself is going to be built and run by the private sector. That's not the government's role. The government's role is to help enable that infrastructure to be built with appropriate policies and to help experiment and understand the kinds of uses that that infrastructure can bring to those who paid for it, the American people, and also how to better deliver the services of government and carry out the public functions, such as health and medicine, education, and the likes.

In many ways the High Performance Computing and Communications Program, the so-called HPCC, provides the technological foundation on which the Administration's National Information Infrastructure rests; that is, the earliest use is in the very esoteric research area, and it's as one goes down in time from there that one finds the proliferation of these uses in other areas of our society.

In February the President and the Vice President at San Jose unveiled what has been called a technology initiative which outlined five elements of the Administration's strategy for building this infrastructure. The first element was to implement the HPCC, which helps develop the basic technology needs for the infrastructure; that is, developing computing, communications, and software technology.

The second element is through the Information Infrastructure Technology and Applications program, to work with industry, universities, and federal laboratories to develop technologies needed to effectively utilize this information infrastructure for a much wider variety of applications than have been used before.

The third element is to provide funding for networking pilot projects through the National Telecommunications and Information Administration, the NTIA, over at the Department of Commerce, and this is being done to demonstrate and explore the benefits of networking, especially on educational and library communities.

The fourth element is to promote the dissemination of federal information. There's a lot of very important information that has been derived and paid for—derived by government and paid for by the taxpayer, but not really that available to taxpayers, and the hope is that—our Administration hopes that we are going to be able to use the new computer and networking technology to make this information more readily available to those people that pay for it.

And, finally, we hope to reform telecommunications policies. The government telecommunications policy, as you know, has not been able to keep pace with the rapid technological development in telecommunications and computer technology. And so to address this problem, the Administration is creating an Interagency Information Infrastructure Task Force at the White House that will work with Congress, the private sector, and state and local governments to find and develop consensus on how to implement policy changes that are needed to accelerate and make more feasible the employment of the National Information Infrastructure.

And as you well understand, this HPCC program is a critical part of the Administration's effort to build the information infrastructure. It's a key part of a comprehensive strategy that will not only develop and demonstrate new technologies, but also will ensure that we have intelligent and forward-looking policies that encourage the private sector to deploy it and for the public to make use of it.

Over the next four years the Administration proposes to spend over $5 billion on this program. Now this $5 billion is a part of the President's investment package, the so-called "Vision for America," in preparing ourselves to be a more resilient economy and take advantage of technology in building the kind of wealth we need to dig our way out of a deep deficit problem that we have. And it seems to me that every time we choose something that takes money to spend, we ought to think very carefully about whether it's an investment that has the kind of payout for our Nation that makes it worthwhile to make that investment, indeed. And if one looks at the extraordinary payout that has accrued so far from this technology and the rate at which this technology is moving, it's very convincing that this is an extremely important investment for us to be making at this time, despite the need to cut our expenses.

In the technology initiative the Administration announced the creation of a program to assist industry in the development of the hardware and the software needed to fully apply advanced computing and networking technology in manufacturing, health care, lifelong learning, and libraries. The Administration requested $47 million in Fiscal Year 1993 and $96 million in Fiscal Year 1994 for that program. The legislation being considered today, as well as provisions in S. 4 and S. 473 being considered by the Senate, are certainly supportive of the same effort.

The new program will be part of the high performance computing and communications program which is being coordinated under the so-called FCCSET Committee, the Federal Coordinating Council for Science, Engineering, and Technology, which I chair, and it will be part of that by adding a fifth component to the program for Fiscal Year 1994 and putting more emphasis on applications throughout the program. This new component, the Information Infrastructure Technology and Applications program, will develop and apply high performance computing and communications technologies to improve information systems needed to address what we would call national challenges; that is, major social societal needs that computing and communications technology can help us address, and these include design and manufacturing, health care, education, digital libraries, environmental monitoring, energy demand management, public safety, national security; you can add to the list.

The President's 1994 budget requests a billion dollars, Mr. Chairman, for the HPCC program, plus $96 million for this new component. And, as I mentioned, the program consists of five integrated pieces, and I will just quickly outline the goals and strategies of those five pieces.

First, in supercomputing hardware, its goal is to develop high performance systems that are a hundred to a thousand times more powerful than those available today. That seems like an extraordinary increase in capability, and yet that is indicative of the rate at which this whole technology is moving.

Second, in networking the National Research and Education Network's goal is to extend U.S. technology leadership in computer communications by a program of research and development that advances the leading edge of networking technology and services.

Third, the supercomputer software development is intended to demonstrate prototype solutions to the grand challenge problems, such as complex weather forecasting or designing better drugs, and this requires some very elegant software development for some of these advanced computers that is a real challenge, I think, to the human mind, and yet its power, once developed, is extraordinary.

Fourth is about basic research and human resources. This element of the program supports research and training and education in computer science, in computer engineering, and in the computational sciences that enhance the infrastructure through the addition of HPCC resources.

And, finally, the information infrastructure technology and applications area, that purpose is to demonstrate the prototype solutions to these national challenge problems using the HPCC enabling technologies, an extraordinary array of things that lie before us that we're now able to do in terms of—I was reading the other day about some of the work in drug design and catalyst design, and it's truly extraordinary. When I was in a laboratory not many years ago, it was not even conceivable that one could think about such design and experimentation and analysis.

While close cooperation between the Federal Government and industry is essential if this technology being developed in the HPCC initiative is really going to be effectively utilized in the national infrastructure, both individually and as members of the HPCC, the participating federal agencies collaborate with their industrial colleagues and partners. They fund research and development in the private sector, and they work together to plan this program out.

There are a significant number of agencies participating in the HPCC program. I think it's one of the best examples of where within the Executive Branch we have been able to utilize and draw together the resources of many different agencies in a way that the whole becomes greater than the sum of the parts, in which the opportunity for overlap or duplication is essentially eliminated, and in which, therefore, we can orchestrate the resources that lie scattered in various agencies for good reason, but bring them together in a coordinated whole that we've simply not experienced before.

My written testimony, Mr. Chairman, outlines the roles and accomplishments to date and implementation plans in this work, but I'll not cover it in my oral remarks this morning.

Now just finally a couple of comments on H.R. 1757, Mr. Chairman: we believe it is important. It's forward-looking legislation. It is largely consistent with the Administration's proposal for developing the National Information Infrastructure. I commend the Chairman and the co-sponsors of this bill for their efforts and their vision in bringing it forward at this time. The legislation will certainly, I think, help accelerate the development of this exciting National Information Infrastructure.

I think the legislation being considered today is in general agreement, as I've been able to read it over these past several days, general agreement with the Administration's goals for the HPCC program and the development of the infrastructure. It supports the expansion of the HPCC program and also places additional emphasis on the development of applications technology for manufacturing, health care, education, libraries, and other important sectors of the economy. It also authorizes additional federal funding for connecting schools and nonprofit organizations to these high speed networks. The legislation includes very important provisions for improving the dissemination of federal information.

My office and all of the other interested agencies have already begun to carefully review the details of this, of H.R. 1757. The Administration will provide as quickly as possible the Committee with its detailed views on the bill, just as soon as our review has been completed and we've been able to coordinate it across the agencies involved.

In the interim, I would like to touch briefly on three concerns of the Administration which I'm sure we'll be able to work with you and your colleagues to address. First, it's important to note that there are not authorizations in the bill for all of the agencies that we feel should play important roles in the development of the applications of the HPCC technology. For example, the Department of Education, the Department of Energy, the Department of Defense, especially the Advanced Research Project Agency, all have key roles to play and they are currently developing plans for their contribution to the National Information Infrastructure. We would hope that their roles and those of other relevant agencies might be also outlined or included in the legislation.

Secondly, section 5 of the bill would amend the High Performance Computing Act of 1991. Subsection 102(d) would restrict the use of the test bed networks that are funded by the HPCC program, and we understand the rationale for that, but we also feel that this could limit the flexibility of the Administration as the Internet undergoes its transition from a subsidized network, used primarily by researchers and educators, to a commercial network being used overwhelmingly by the private sector. The legislation could complicate the already difficult tasks of both spurring development of the private sector networks and continuing to provide inexpensive network services to federally-funded researchers and educators.

And, third, section 6 of the bill would amend the National Science and Technology Policy Organization and Priorities Act of 1976, which created the OSTP, to allow the appointment of a fifth Associate Director who would oversee federal efforts to disseminate scientific and technical information. We believe the Organic Act presently allows the Director important discretion in assigning the key responsibilities to the Associate Directors, and I am in the process just this week of trying to come grips with exactly how to reorganize the office to reflect the priorities of the Clinton Administration and to enable the office to function more effectively, in a more streamlined way. Now this might be much more difficult if any or all of the roles of the Associate Directors were to be defined by statute. So I trust that we'll be able to work with you and your colleagues to find language that's appropriate and acceptable to both you and the Administration in this regard, Mr. Chairman.

In conclusion, I want to thank you and the other Members for this opportunity to appear before you today. The Administration is committed to the sustained development of a National Information Infrastructure in partnership with the private sector. This commitment is reflected in both the President's technology initiative and in the Administration's Fiscal Year 1994 budget request. Your proposed legislation will help provide greater access to the Internet and will certainly accelerate the development of applications of high performance computing and communications technology in the areas of primary and secondary education, health care, libraries, and other essential public areas.

We look forward to working with the Committee on this legislation and we believe that there are few technological initiatives that offer as many potential benefits for all Americans as this technology and the initiative that you support.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Gibbons follows:]

Statement of John H. Gibbons
Director, Office of Science and Technology Policy

before the

Committee on Science, Space, and Technology
U.S. House of Representatives

April 27, 1993

INFORMATION INFRASTRUCTURE AND HR1757, THE "HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993"

Mr. Chairman, Members of the Committee, thank you for this opportunity to testify on the Administration's High Performance Computing and Communications Program and its important role in assisting the development of the National Information Infrastructure.

This information infrastructure consists of computers, computer data banks, fax machines, telephones, and video displays linked by high-speed telecommunication links capable of transmitting billions of bits of information in a second--an entire Encyclopedia Britannica in a few seconds. The computing and networking technology that makes this possible is improving at an unprecedented rate, expanding both our imaginations for its use and its effectiveness. Using these technologies, a doctor who needs a second opinion could transmit a patient's entire medical record--x-rays and ultrasound scans included--to a colleague thousands of miles away, in less time that it takes to send a fax today. A school child in a small town could come home and through a personal computer, reach into an electronic Library of Congress--thousands of books, records, videos, and photographs, all stored electronically. At home, viewers could choose whenever they wanted from thousands of different television programs or movies.

As you know, the Administration is committed to accelerating the development of the National Information Infrastructure (NII) this Nation needs for the 21st Century. This infrastructure will provide Americans the information they need, when they need it, whether in the form of text, images, video, or sound. These "information superhighways" will revolutionize the way we work, learn, shop, and live. They promise to have an even greater impact than the interstate freeways or the telephone system. This infrastructure will be as ubiquitous as the telephone system, but will be able to carry information at least 1,000 times faster. It will be able to transmit not only voice and fax, but will also provide hundreds of channels of interactive high-definition TV programming, teleconferencing, and access to huge volumes of information.

This technology is already in use in many of our research laboratories where it is transforming the way research is done. It allows scientists and engineers to access information from computer databases scattered throughout the country and enables them to use supercomputers and research equipment thousands of miles away. Perhaps most importantly, it enables researchers to collaborate with colleagues around the country and around the world almost as easily as if they were in the same building.

This same telecommunications and computing technology could someday be available to all Americans, provided there is adequate public and private investment and forward-looking government policies that promote its deployment and use.

The Clinton Administration believes that the Federal government has several important roles to play in assisting the development of this infrastructure, which will be built and run primarily by the private sector. In many ways, the High Performance Computing and Communications (HPCC) Program provides the technological foundation upon which the Administration's strategy for the NII rests. On February 22, the President and the Vice President unveiled a Technology Initiative which outlined the five parts of the Administration's strategy for building the National Information Infrastructure:

1) Implement the High-Performance Computing and Communications Program, which is helping develop the basic technology needed for the NII.
2) Through the Information Infrastructure Technology and Applications program, work with industry, universities, and Federal labs to develop technologies needed to effectively utilize the NII for a wide range of applications.
3) Provide funding for networking pilot projects through the National Telecommunications and Information Administration (NTIA) of the Department of Commerce. NTIA will provide matching grants to assist states, local governments, universities and school systems, hospitals and other health care providers, and other non-profit entities in purchasing equipment and in undertaking planning related to telecommunications infrastructure development. These pilot projects will demonstrate and explore the benefits of networking in the educational and library communities.
4) Promote dissemination of Federal information. Every year, the Federal government spends billions of dollars collecting and processing information (e.g. economic data, environmental data, and technical information). Unfortunately, while much of this information is very valuable, many potential users either do not know that it exists or do not know how to access it. The Administration is committed to using new computer and networking technology to make this information more available to the taxpayers who paid for it. This will require consistent Federal information policies designed to ensure that Federal information is made available at a fair price to as many users as possible while encouraging the growth of the information industry.
5) Reform telecommunications policies. Government telecommunication policy has not kept pace with new developments in telecommunications and computer technology. As a result, government regulations have tended to inhibit competition and delay deployment of new technology and services. For instance, without a consistent, stable regulatory environment, the private sector will hesitate to make the investments necessary to build the high-speed national telecommunications network that this country needs to compete successfully in the 21st Century. To address this problem and others, the Administration is creating

a high-level, interagency Information Infrastructure Task Force at the White House that will work with Congress, the private sector, and state and local governments to find consensus on and implement policy changes needed to accelerate deployment of the NII.

As you can see, the HPCC Program is a critical part of the Administration's effort to build the NII. It is a key part of a comprehensive strategy that will not only develop and demonstrate new information technology, but also ensure that we have intelligent, forward-looking policies that encourage the private sector to deploy it and the public to use it. Over the next four years, the Administration is proposing to spend over $5 billion on this Program.

Scope

For more than 10 years, the Science, Space, and Technology Committee has been a leader in the area of information technology and information policy. Legislation sponsored by this Committee, the "Supercomputer Networking Study Act of 1986," mandated a report by the White House Office of Science and Technology Policy (OSTP) that helped lay the foundation of the High Performance Computing and Communications Program. The High-Performance Computing Act of 1991, first introduced by then-Senator Gore and championed in the House by Representatives Brown, Boucher, Valentine, and others, authorized and defined that program.

When then-Senator Gore proposed the idea of a High-Performance Computing Initiative more than five years ago, most people believed it would primarily benefit the research and higher education communities. And its first users have been scientists, engineers, and university educators. The supercomputer technology developed under this program has helped users to improve our understanding of global warming, develop new drugs, design safer and more fuel-efficient cars and aircraft, and access huge "digital libraries" of information. The high-speed networking technology developed and demonstrated by the HPCC Program and industry has accelerated the growth of the Internet computer network and enabled millions of users not just to exchange electronic mail, but to access computers, digital libraries, and research equipment around the world. This technology, which allows network users to conduct video conferences at their desk, is enabling researchers around the country to collaborate more effectively.

The technology now used by the research and development community could provide huge benefits in other sectors of our economy. Unfortunately, much of this technology is "leading-edge" technology that is still experimental and difficult to use. That is why, in the Technology Initiative of February 22, the Administration announced creation of a program to "assist industry in the development of the hardware and software needed to fully apply advanced computing and networking technology in manufacturing, in health care, in life-long learning, and libraries." The Administration requested $47 million for FY93 and $96 million for FY94 for this program. The legislation we are considering today, as well as provisions in S. 4 and S. 473 being considered by the Senate, support these efforts.

This new program will be part of the High-Performance Computing and Communications Program, which is coordinated by the High Performance Computing and Communications and

Information Technology (HPCCIT) Subcommittee of the Federal Coordinating Council for Science, Engineering and Technology (FCCSET), which I chair. The HPCCIT has incorporated this new program into the HPCC Program by adding a fifth component to the program for FY'94 and by putting more emphasis on applications throughout the program. This new component, Information Infrastructure Technology and Applications (IITA), will develop and apply high performance computing and communications technologies to improve information systems needed to address what we call "National Challenges"--major societal needs that computing and communications technology can help us address--and include design and manufacturing, health care, education, digital libraries, environmental monitoring, energy demand management, public safety, and national security. These National Challenges are analogous to the "Grand Challenge" research problems which have been the primary focus of the HPCC Program to date. In addition to addressing these problems, this new component will support the development, with industry, of the NII and the development of the computer, network, and database technology needed to provide appropriate privacy and security protection for users.

Components of the HPCC Program

The President's FY 1994 budget requests $1 billion for the HPCC Program plus $96 million for the new IITA component. As I mentioned, the Program consists of five integrated components. Let me outline the goals and strategic priorities of each.

1. HPCS (High Performance Computing Systems) -- Its goal is to extend U.S. technological leadership in high performance computing through the development of scalable computing systems, with associated software, capable of sustaining at least one trillion operations per second (teraops) performance. Scalable parallel and distributed computing systems will be able to support workstation users through the largest-scale highest-performance systems. Workstations will extend into portable wireless interfaces as technology advances.

2. NREN (National Research and Education Network) -- Its goal is to extend U.S. technology leadership in computer communications by a program of research and development that advances the leading edge of networking technology and services. NREN will widen the research and education community's access to high performance computing and research centers and to electronic information resources and libraries. This will accelerate the development and deployment of networking technologies by the telecommunications industry. This includes nationwide prototypes for terrestrial, satellite, wireless and wireline communications systems, including fiber optics, with common protocol support and application interfaces.

3. ASTA (Advance Software Technology and Algorithms) -- Its purpose is to demonstrate prototype solutions to Grand Challenge problems through the development of advanced algorithms and software and the use of HPCC resources. Grand Challenge problems are computationally intensive problems such as forecasting weather, understanding climate changes, improving environmental quality, building more energy-efficient cars and airplanes, designing better drugs, and conducting basic scientific research.

4. BRHR (Basic Research and Human Resources) -- This element supports research, training, and education in computer science, computer engineering and the computational sciences and

enhance the infrastructure through the addition of HPCC resources. Initiation of pilot projects for K-12 and lifelong learning will support expansion of the NII.

5. IITA (Information Infrastructure Technology and Applications) -- Its purpose is to demonstrate prototype solutions to National Challenge problems using HPCC enabling technologies. This will support integrated systems technology demonstration projects for critical National Challenge applications through development of intelligent systems interfaces. These will include systems development environments with support for virtual reality, image understanding, language and speech understanding, and data and object bases for electronic libraries and commerce.

Close cooperation between the federal government and industry is essential if technology developed by the HPCC Initiative is to be effectively used to build an advanced NII. Both individually and as members of the HPCC Initiative, the participating agencies collaborate with industrial partners, fund research and development in the private sector, and work together to plan the HPCC Program. In addition, my office is working on a High Performance Computing Advisory Committee consisting of representatives from the private sector and academia and we note with approval your proposed legislation's broadening of the membership of the advisory group to include representation from the K-12 education community and from consumer and public interest groups.

Agency Roles in the HPCC Program

The HPCC Program has been a model of how Federal agencies with different missions can work together effectively toward a common goal. The participating agencies have built a coherent coordinated program that is far greater than just the sum of its parts. They have eliminated wasteful duplication of effort and research dollars and found and exploited opportunities for joint projects. This kind of synergy ensures the best use of Federal research dollars.

Allow me next to briefly outline for you the roles, the accomplishments to date, the implementation plans, and the FY 1994 proposed activities for the agencies that take part in the HPCC Program. No single agency has expertise in all areas of HPCC technology; each plays an essential role. Agencies participate in the HPCC Program in support of their individual missions, overall Program goals, or both. The agencies and their roles (as outlined in a recent OSTP summary of the FCCSET programs) are:

-- The Advanced Research Projects Agency (ARPA) coordinates the advanced computing and networking technologies needed by the Program. ARPA supports projects throughout academia and industry to accelerate innovation and the transition of advanced concepts into new technologies for use within the Program and the defense and national technology base. The projects are developing the full range of technologies needed for a scalable technology base of interoperating workstations, networks, and parallel computing systems with mass storage, systems software and development tools. This technology will enable a rapid transition from concepts to computational and integrated system solutions in an open heterogeneous computing environment. This will enable solution of the Grand Challenges and other National Challenges while providing the foundation for a NII.

-- The National Science Foundation (NSF) supports advanced fundamental research in HPCC technologies and their application to science and engineering problems. While coordinating the NREN component, NSF is upgrading NSFNET backbone services, deploying networking information services, increasing network connections, and expanding gigabit research and development. NSF supercomputer centers are collaborating towards a "metacenter." NSF enables coordinated approaches to Grand Challenge problems, and addresses algorithm and software technology issues and providing computational research and educational programs from the secondary schools through the postdoctoral level. Expanded IITA research includes distributed databases and digital libraries, multimedia computing and visualization, and image recognition.

-- The Department of Energy (DOE) funds HPCC research on parallel systems, software, and gigabit networks technology. It funds Grand Challenge research in future energy sources, fusion energy, combustion, environmental remediation, ground water flow, petroleum reservoir modeling, atmospheric and ocean modeling, and structural biology. DOE supports high performance computing centers and the Energy Sciences network, ESNET. Collaborations between DOE investigators and industry include a joint effort by DOE, NASA, six major industrial firms to establish the National Storage Laboratory, which addresses the pressing mass data storage problems. The DOE has education and training programs in computational sciences and other HPCC technology areas for secondary schools through the doctoral level. IITA research includes areas such as energy demand management and telecommuting.

-- The National Aeronautics and Space Administration's (NASA) high performance computing centers address Grand Challenge problems such as improving advanced aerospace vehicles (including high speed civil transport); simulating an entire vehicle through the full flight envelope; advanced robotics for space exploration; modeling the interactions among the atmosphere, oceans, and land masses; deploying NASA's high performance NREN; and managing huge volumes of space data. NASA coordinates the ASTA component's software sharing activity, and participates in gigabit network research. NASA conducts educational pilot programs with elementary and secondary schools and supports university research. IITA efforts include increasing accessibility of remotely sensed data and developing technologies to manipulate these large volumes of data.

-- The National Institutes of Health (NIH), through its National Library of Medicine, National Center for Research Resources, Division of Computer Research and Technology, and the Biomedical Supercomputer Center of the National Cancer Institute, develops algorithms and software in molecular biology (including comparison of genetic and protein sequence data) and biomedical imaging for high performance systems; develops prototype biomedical digital image libraries; provides NREN access to researchers and medical centers; supports training at all levels in high performance computing for medical applications and provides fellowships in medical informatics. NIH IITA efforts will expand technology development for telemedicine, medical record management, and medical imagery.

-- The National Security Agency (NSA), Department of Defense, conducts research in all aspects of highly heterogeneous computing environments, including specialized high speed hardware. NSA focuses on interoperability, increased performance, network and computer security, mass storage, and gigabit networks. NSA promotes research in high performance computing including superconductivity and ultra high-speed-switching at its own facilities, in industry, and at universities.

-- The National Oceanic and Atmospheric Administration (NOAA), Department of Commerce, conducts Grand Challenge research in climate prediction and weather forecasting, and archives and disseminates environmental data, including climatic data for the Global Change Research Program. By exploiting the computing power of scalable parallel systems, global ocean and atmosphere models will accurately represent weather fronts and ocean eddies, and distortions due to clouds can be eliminated. In support of this research, NOAA is acquiring scalable systems and enhancing NREN connectivity. Within the IITA component, NOAA is investigating environmental monitoring, prediction and assessment applications, and expanding efforts to make its environmental data more accessible.

-- The Environmental Protection Agency (EPA) conducts Grand Challenge research in air and water pollution management and in ecological assessment in a distributed, heterogeneous high performance computing environment. The research focuses on improving environmental decision-making and policy support tools, improving NREN connectivity, and developing and implementing training programs, particularly for state and environmental groups. EPA is integrating user-friendly advanced assessment tools into a high performance computing environment, which will include a scalable parallel system to enable more complex multipollutant and multimedia assessments.

-- The National Institute of Standards and Technology (NIST), Department of Commerce, develops instrumentation and performance measurement methods for high performance computing and networking systems; develops security policies and technologies for the NREN; facilitates the development of appropriate voluntary standards; and designs and implements methods for organizing, documenting, and disseminating software. As coordinating agency for manufacturing applications for the IITA component, NIST will establish an advanced manufacturing systems and networking testbed. NIST will work closely with DOC's National Telecommunications and Information Administration (NTIA). NTIA has a key role in developing Federal telecommunications policy and funding networking pilot projects at schools, libraries, hospitals and health care providers, and other non-profit institutions.

-- The Department of Education (ED) sponsors program initiatives and activities through its regional laboratories and research centers. The Department will provide information to educators and students in K-12 and lifelong learning about high performance computing and networking application resources. It promotes initiatives in training, curriculum development, library connectivity and research and development projects that support the emerging information infrastructure.

HR1757 - "High Performance Computing and High Speed Networking Applications Act of 1993"

HR1757 is important, forward-looking legislation and is largely consistent with the Administration's proposal for developing the nation's information infrastructure. I commend the Chairman and the cosponsors of this bill for their efforts and their vision. This legislation can help accelerate the development of a National Information Infrastructure.

I believe that the legislation being considered today is generally consistent with the Administration's goals for the HPCC Program and the development of the National Information Infrastructure. It supports the expansion of the HPCC Program and additional emphasis on development of applications technology for manufacturing, health care, education, libraries, and other sectors of the economy. It also authorizes additional Federal funding for connecting schools and non-profit organizations to high-speed networks. The legislation includes very important provisions for improving the dissemination of Federal information.

We share the committee's desire that scientific and technical information be made more available to the taxpayers who paid for it. Scientific and technical information (STI) is a multi-billion dollar annual enterprise which provides the critical raw material of research and development as well as a tangible output of our R&D investment. It is estimated that between 2 percent and 4 percent of each Federal research dollar is spent on the management of STI. When effectively mobilized, STI programs can provide input to the solution of major technical problems. From large earth observing experiments to genome databases to computational science research to using scientific visualization for new scientific insights, rapid advances in information technologies combined with an increased volume of data and information have brought renewed recognition of the importance of information management in the science and technology program life cycle.

HR1757 was just introduced on April 21st. This office and all of the other interested agencies have already begun to carefully review the details of the Bill. The Administration will provide the Committee with its views on the Bill as soon as the review has been completed

Conclusion

Thank you again for this opportunity to appear here today. The Administration is committed to the rapid development of the National Information Infrastructure. This commitment is reflected in both the President's Technology Initiative and Administration's FY94 budget request. Your proposed legislation will help provide greater access to the Internet and accelerate development of applications of high-performance computing and communications technology in the areas of primary and secondary education, health care, libraries, and access to government information. We look forward to working with the Committee on this legislation and on the development of the National Information Infrastructure. There are few initiatives that offer as many potential benefits to all Americans.

Mr. BOUCHER. Dr. Gibbons, thank you very much both for your broad statement of vision with regard to the Administration's initiative and for your generally favorable comments with regard to the legislation that is pending before us today. We have noted your specific areas of suggestions for refinement and we will be glad to work with you and your staff as we address those specific concerns.

I also note your statement that you and the various research agencies are now reviewing the detailed provisions of the bill and that you hope to have some recommendations for us on other provisions within the near future. Can you, for our planning purposes, give us some indication as to when those additional recommendations might be forthcoming?

Dr. GIBBONS. If you'll give me a moment to confer with my colleagues, Mr. Chairman, I will respond.

[Dr. Gibbons confers with his colleagues.]

Dr. GIBBONS. We have total consensus that within a week or two we should be able to provide you with that information. [Laughter.]

Mr. BOUCHER. Well, that's excellent. I certainly could not ask for more rapid cooperation than that.

[The information follows:]

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

May 24, 1993

Dear Mr. Chairman:

When I testified before your Subcommittee on April 27 on H.R. 1757, the "High Performance Computing and High Speed Networking Applications Act of 1993", I indicated that the Administration was still reviewing the legislation. Enclosed are the Administration's detailed comments on the bill.

As I indicated at your hearing, H.R. 1757 is largely consistent with the Administration's proposal for developing the nation's information infrastructure. The total authorization levels provided by the bill are similar to the funding levels proposed by the Administration (even though some of the allocations to individual agencies are not). The Administration does have specific concerns about some of the other provisions of the legislation that we hope to work with you and your colleagues in Congress to address. In addition, the Administration may in the future suggest additional language, particularly to describe the roles of those agencies not covered by the original version of the bill.

I want to thank you, Chairman Brown, and the other members of the Science Committee for your efforts at accelerating development of an advanced information infrastructure, and hope that the enclosure will be of assistance to the Subcommittee. The Office of Management and Budget advises that, from the standpoint of the Administration's program, there is no objection to submission of these comments on H.R. 1757 for the Committee's consideration.

Sincerely,

John H. Gibbons

John H. Gibbons
Director

The Honorable Rick Boucher
Subcommittee on Science
Committee on Science, Space, and Technology
United States House of Representatives
Washington, DC 20515

Enclosure

DETAILED COMMENTS ON H R 1757

Addition of Title III to the High-Performance Computing Act of 1991

Section 301

Issue Ambiguity about organization of the Application Program

Discussion It is not clear from Section 301 whether the Applications Program will be part of the High-Performance Computing (HPC) Program created by the High-Performance Computing Act The Administration has proposed creating an applications program under the HPC Program, since for the most part the same agencies and staff will be involved in both However, the Administration would like to have the flexibility to create a separate multi-agency applications program in the future

Solution Amend Section 301 as follows:

> At the end of line 25, page 4, insert "This program may be part of the Program described in section 101 "

Section 302 and 303

Issue Object to 302(b) (3) and 303 (3) - unnecessary in statute and should not proscribe funding levels on budget process

Section 304

Issue Flexibility of the Office of Science and Technology Policy

Discussion This section would require that a specific member of the OSTP staff be responsible for overseeing the High-Performance Computing Program Dr Don Lindberg, the Director of the National Library of Medicine and Special Assistant to the Director of OSTP for HPCC, has done an excellent job of coordinating the HPCC Program However, establishing this position in statute limits the Administration's flexibility with regards to management of the program in the future For instance, in a few years, it may be desirable to give someone from a particular agency responsibility for coordinating the program rather than giving an OSTP staff member that task

Solution Delete Section 304

Section 305

Issue: Unnecessary reporting requirement

Discussion: Although similar language is in the original High-Performance Computing Act, it is best if the President has the discretion to define the elements of his budget request. Further, it is unnecessary to require in law a separate annual report to OMB from each agency on its role in the applications program. The agencies involved in the HPCC Program do provide this information to OMB presently, but particularly for the smaller agencies, it may not be provided in the form of a separate report.

Solution: Delete Section 305

Section 306

Issue: Authorization levels for the Connections program

Discussion: The Administration supports whole-heartedly the Connections program and other efforts by the National Science Foundation to connect more schools to the Internet. NSF has been particularly helpful in teaching teachers and students how to use networks like the Internet. For FY94 we are requesting additional funding for these programs. However, NSF is not the only agency helping to get schools on-line. The Administration is requesting $54 million for FY94 for the National Telecommunications and Information Administration of the Department of Commerce to provide matching grants to assist State, local governments, universities and school systems, hospitals and other health care providers, and other entities to be able to take advantage of the telecommunications infrastructure. This program will serve a broader constituency than the Connections Program and utilize a number of other telecommunications technologies in addition to the Internet. Given the NTIA program, the authorization levels for NSF in the bill are higher than necessary. In addition, it may not be useful to provide a five-year authorization for a program that should be seriously evaluated after two or three years as technology and schools' needs change.

Solution: Amend Section 306 as follows:

> Lines 3-6, page 12, strike everything following "section," and insert the following:
>
> "$15,000,000 for fiscal year 1994 and $30,000,000 for fiscal year 1995."

Section 309(a)

Issue Specific centers are not identified for the CDC and should not be for NIH

Solution Amend Sections 309(a) as follows

Delete National Library of Medicine on line 17, page 16

Section 309(b)

Issue Health-related research should be included under "Applications for Health Care"

Discussion. Basic and clinical biomedical research performed at the NIH and other agencies is critical to the development of new and improved, more cost-effective methods for disease prevention, early detection and treatment. Many aspects of this research are very computationally intensive and require the latest computing technologies and represent a major stimulus to industry to develop faster and more cost-effective computers. The research involves several of the "Grand Challenge" problems of computer assisted-rational structure-based drug design, improved understanding of the organization of the human genome, protein structure determination, and protein structure prediction based on genomic information, computational molecular biology, computational chemistry, virtual reality applied to biomedical problems such as simulation of surgery for training surgeons and optimizing surgical approaches to individual patients, optimization of radiotherapy for patients with cancer, and the optimal dissemination of information to researchers nationwide, to improve the efficiency and cost-effectiveness of the research and development process.

Solution Amend Section 309(b)

On line 21 page 16 add after Clinical Information Systems "and Health-Related Research"

After line 17 page 17 add

(7) Computer-assisted drug design to reduce the time and cost of drug development
(8) Three-dimensional geometric modeling and artificial intelligence methods for interpreting an array of medical images, and
(9) Complex simulations of sociological populations impacted disproportionately by selected diseases or disorders.

General comments on Title III

It is important to note that several agencies which have important roles in developing applications of HPCC technology are not authorized funding under this title. In addition to the Department of Education, the Department of Energy and the Department of Defense (particularly its Advanced Research Projects Agency) have key roles to play and have developed plans for their contribution to the new Information Infrastructure Technology and

Applications Program proposed by the Administration. We would hope that their roles could be defined in the legislation, too.

The legislation does not include authorizations for fiscal year 1993 even though the Administration requested supplemental appropriations for an applications program as part of its stimulus package. Funding levels requested were: $19 million for the National Science Foundation, $5 million for NASA, $9 million for NIH, and $14 million for NIST.

Section 4

Section 4

Issue: Appointment of Advisory committee members

Discussion: It would be more logical to have the Director of OSTP appoint Advisory Committee members, since they report to the Director and not the President.

Solution: On line 17 page 24 replace "President" with "the Director of OSTP"

Section 5

Issue: Limits the flexibility of the Administration in commercializing the Internet

Discussion: This section is vague and would limit the flexibility of the Administration as the Internet undergoes a transition from a subsidized network used primarily by researchers and educators to a commercial network used primarily by the private sector. This legislation could needlessly complicate the already difficult tasks of both spurring development of private sector networks and continuing to provide inexpensive networking services to Federally-funded research and educators.

Subsection (d) would seem to prohibit Federal agencies from funding testbed networks which piggy-backed on private sector network facilities used for commercial services. In order to leverage its funds and spread the cost, NSF has contracted with commercial network companies for NSFNET, which have provided advanced networking services to NSFNET users while providing lower-speed services to other customers. Requiring that testbed networks only be used for high-end applications would lead to greatly increased costs.

This language could also have the effect of prohibiting agencies from funding networks for connecting their own facilities if those networks were to be connected to or might be construed as being part of the testbed networks defined in this act. NASA and DOE both fund networks connecting their own laboratories to each other and to the Internet that provide both specialized network services and services that could be provided by commercial networks run by the private sector.

By limiting services on the testbed to only those services that could not be provided satisfactorily using commercial networks, this language would prohibit funding of the kind of large demonstration projects involving thousands of users that are necessary to provide a realistic test of new networking protocols and hardware. Many or most of these users would be using the network for services that might also be available commercially. Without this kind of large testbed network it will be much more difficult to adequately test new types of network architectures and protocols.

There is a clear need to ensure that Federally-subsidized networks are not being used for purely commercial traffic and thus depriving private-sector telecommunications companies of potential customers. For this reason, the Administration is moving to ensure that the Federally-subsidized backbone networks are reserved for use by researchers and educators. In the coming years, there will be fewer people relying on such subsidized networks, since many Federally-funded researchers and educators will recieve Federal funding to purchase commercial networking services--in much the same way they use grant money today to covers the cost of telephone service. This will ensure that Federal subsidies are properly distributed and accelerate creation of commercial networking companies. However, this process will take longer than the 18 months allotted by subsection (d), especially in rural areas where Federally-subsidized networks like NSFNET or ESNet are the only high-speed networks available.

Solution: Delete all of Section 5. Subsection (d) could be included if there is a perceived need to ban commercial traffic on Federally-subsidized networks and the following language was substituted for paragraph (d)(1):

"Federal funds authorized under this program shall not be used for the purpose of carrying traffic between commercial entities for purposes unrelated to the Program or the missions of participating agencies."

Section 6

Issue: Limits flexibility of the OSTP Director

Discussion: OSTP's organic act allows the Director discretion in assigning responsibilities to the Office's Associate Directors. Defining the roles of the Associate Directors in statute would make it much more difficult to reorganize the office to meet changing needs and Administration priorities.

Solution: Delete Section 6.

Mr. BOUCHER. I noted with interest your statement about the relative roles of the government on the one hand and the private sector on the other, in terms of developing this high speed information superhighway, and let me just go over that with you perhaps in some greater detail.

Would you agree generally with the statement that the network itself in terms of the fiber optic lines and the switches and the other hardware that will make the connections possible should generally be provided by the private sector and that the government's role by contrast ought to be the funding of research and development for new networking technologies, the creation of standards and protocols that will make sure that the network operates in a compatible fashion throughout the country, and the provision of direct connections for limited purposes, such as for schools and libraries and state and local governments?

Dr. GIBBONS. I think you spelled it out precisely and correctly as far as I'm concerned, Mr. Chairman. The government's role is one of catalysis, of trying to help not only support basic research and the development of socially-relevant technology, but also providing a seed bed in which the private sector than can be attracted to transform this into the kind of reality that we have. I'll just give you a small analogy.

The government, through it's long-term support of basic research and applications, particularly basic research, in the area of molecular biology, has built the foundation that has been transformed by the private sector into the biotechnology community. There's no way the government ought to be out trying to reproduce the efforts of Genetech and other companies that are transforming this knowledge into important products and services.

And I think the same in information. We have supported and should be very pleased with the way that public monies flowing through ARPA, NSF, and other agencies have provided a basis in partnership with important developments in the private sector, so that we now have the technological capability to do a lot of things. The government's role seems to be several-fold.

One is to provide the policy environment that will enable these ideas to flourish in terms of private investment and the putting in place of these things from the private sector. The second is that the government has its own continuing self-interest in understanding how such a facility can be helpful in delivering public services, how the government's own delivery of services and activities can most fully utilize these capabilities. So I think we have a continuing sort of a partnership that shifts in its detail nature, but still is one in which the government and the private sector see very clearly their separate roles, but they're mutually reinforcing.

Mr. BOUCHER. Along that line, we have made an effort in this bill to continue, and perhaps even accelerate, the process that is already underway at the National Science Foundation, where the trend now is to encourage that access to the network that could be provided by the private sector, in fact, be provided by the private sector, so that you would not have traffic traveling over the NSFNET today that could travel over a private, commercial network. To the extent that direct financial support should be provided to the research and education community in order to purchase those connections over the private network, the second goal of this new direction would be to have that direct financial support provided.

What we have in our legislation for the NREN is just a direct requirement that that series of events take place, and we basically say that within 18 months of enactment of the bill that there could no longer be on the test bed network traffic that could otherwise be carried on private commercial networks.

I know that some expressions of concern are being generated from the user community today that perhaps the transition into that new era might not be particularly smooth and that we might have some difficulty in having the funding research—the agencies that fund research actually be prepared to provide that direct financial support to the end users so they could purchase connections.

I noted that you made some reference to this general concern during the course of your statement, and I would like to ask you to elaborate a bit on that because I'm confident that we'll hear additional testimony from others that addresses that specific subject.

And before you answer, let me say that I personally think it makes sense to move in the direction that the NSF has already targeted. And to the extent that we can do that appropriately through legislation in this measure, we should. But it's important that we assure that smooth transition, and so your general comments on how that transition might come about and what specific provisions we need in the legislation in order to enhance it would be most welcome.

Dr. GIBBONS. Well, I applaud in principle your effort; namely, to provide the mechanism for a seamless transition between direct subsidy of utilization of this capability, which in turn encourages people to innovate and do things they otherwise might be constrained from doing simply because they didn't have the resources, and make that transition over to the point where there is a recognized market signal of the price, the cost of doing business and then a reimbursement that occurs. So instead of direct subsidy in the first instance, one moves toward reimbursement in the other instance. It also provides the private sector an opportunity to better justify its investments and, therefore, lower the opportunity cost of its capital, and, therefore, lower the cost of services that they can offer. So I think in principle it's a very important thing to encourage and to monitor and to see that it happens.

On the other hand, I think the timing of the transition may be something that needs some additional attention. I'm not about to say that 18 months is wrong, but I'm just not certain at this point that it's a long enough time for some kinds of transitions to occur. And so it seems to me that might merit a little more exploration.

Mr. BOUCHER. Well, we will certainly work with you and your staff as we seek a way to accomplish that smooth transition, both in terms of time tables and in terms of the substance of what we're seeking to accomplish.

One of the items that you also noted in your testimony relates to our proposal in the legislation that there be another Associate Director designated in the Office of Science and Technology Policy with essential responsibility for this applications program and for other aspects of developing the information superhighway. And you note some concern about the statutory direction that that designation occur.

One of the criticisms that some have leveled at the current high performance computing program is that it doesn't have sufficient central authority, not because there's any inadequacy in the Office of Science and Technology Policy, but simply because the statutory provision itself inhibits that office from having the strong, central coordinating role that many think is necessary.

It, for example, cannot issue directives to the various research agencies. It does convene the interagency planning process under FCCSET, but doesn't have the authority, actually, to direct the carrying out of research. Now what we're trying to do is address that concern, and we may have done it somewhat imperfectly, but I'd like to have your thoughts on other ways that that might be accomplished, and perhaps even in a broader vein, your general view on how we might provide that more central planning and coordinating authority that this program, once it has new applications designated in this statute, obviously will require.

Dr. GIBBONS. Mr. Chairman, I very much appreciate your concern there and I share the conviction that the office organization can be improved to be more effective. As the President said, he wanted to strengthen the office, and what we've been concerned about is how do we strengthen the office in a generic sense now that we also are responsible for the National Space Council and the Critical Materials Council as well.

We've been undergoing an internal analysis of how we can not only absorb those earlier separate functions, but also organize the office—and we do believe it may take some legislative changes—how we can make this office more effective and more streamlined. The case of Information Systems is a good example, in a sense, like space issues, that are inherently cross-cutting across science, technology, international relations, other areas. So our question is: how can we organize the best—provide the kind of oversight and leadership in these areas without having 100 different Associate Directors? We do hope to be able to come to you at least informally with some ideas within the next couple of weeks, and I would very much appreciate the assistance of this committee in testing out our ideas.

We do feel, however, that the role of FCCSET, the so-called Federal Coordinating Council, is a very important idea that had some fruition during my predecessor's time, Alan Bromley, and which we intend to even build into a more strong and effective system. With me today is Dr. Don Lindberg, who, for example, not only runs the National Library of Medicine as its Director, but is the Chairman of the National Coordination Office for the HPCC. So Don sits as essentially my voice and presence to chair this very large committee that meets monthly, I believe it is, at the Library of Medicine, and these are extraordinary meetings where there are perhaps two dozen people around the table from all of the relevant agencies working together and communicating together on these issues.

So the role is there and I think the FCCSET process is going to be a very important part of the reinvigorated OSTP, and I very much appreciate your concern and hope I can call on you in about two weeks.

Mr. **Boucher**. Well, you certainly can, and perhaps as we have those discussions we might consider a more generic strengthening of the FCCSET process statutorily, as a way not only to address the concerns that we have with coordinating the high performance computing program, but also coordinating other multi-agency research efforts across the government.

Dr. **Gibbons**. I might add, Mr. Chairman, that my boss, President Clinton, feels very strongly that the execution of the executive programs and policies should be done through his agencies and his directors of departments, the Cabinet. At the same time, he understands—and the Cabinet does—that many of them have roles to play in an overarching common set of objectives in which they have to reintegrate themselves across the executive. And they, in the areas of science and technology, they are looking to OSTP to help play that role, not to be the boss, but to be the integrator, the catalyst, to bring these folks together, so that their collective strength is greater than the sum of their individual strengths.

We feel that that's the case. We are very pleased that people at the very highest levels of these agencies are working with us on these FCCSET committees. And so we have good reason to believe that we can provide leadership and coordination and integration, and at the same time not be seen as people who are trying to run these programs out of the White House, which is the last thing we want to do.

Mr. **Boucher**. Dr. Gibbons, thank you very much.

The gentleman from New York, Mr. Boehlert.

Mr. **Boehlert**. Thank you very much, Mr. Chairman.

Thank you, Dr. Gibbons. I look forward to your more definitive response in this proposal in a couple of weeks, and I can appreciate the problems you're encountering, a new administration, getting everybody aboard, but, obviously, this is one of the Vice President's strong initiatives, and I would anticipate we'll have enthusiastic and very definitive support when the time comes.

But one of the problems we're going to have is money, and you know that. First of all, a cursory glance as you look at this bill, do you view this as a lot of new money or money that you pretty well had already envisioned you would be spending and requesting?

Dr. **Gibbons**. I haven't had a chance to look at the details of the funds authorized in the bill, Mr. Boehlert, in terms of where the money would be derived. You're speaking of the funds in the bill. So I'd rather not try to give you a full answer on that at this point.

I would say, though, that we are working very hard in areas like this to find when and wherever we can opportunities within the agencies to shift resources from less important things to more important things, and we believe that a lot of opportunity lies there, that one shouldn't just always go out and be looking for brand-new money because we're not going to find it.

Mr. **Boehlert**. Yes, that's a very difficult task; I know it. Everyone on this Committee and everyone in this Congress is going to totally embrace the concept. They want to move ahead with it, but then they're going to be very reluctant, I'm afraid, in many instances to approve the dollars. So I think you're absolutely correct, one of the things we have to do is sort of reprioritize, and I can sense that you're sensing where I'm going to be coming from. I'll give you some help with the Administration. If you want some funds for some of these important projects like this, I suggest you take a look at a line item in the budget called the Superconducting Supercollider. [Laughter.]

We've got billions there, and we can transfer those billions into something very worthwhile like this.

Dr. Gibbons. I was afraid you might say the B-Factory.

Mr. Boehlert. Well, no, I've got some comment on B-Factory, too, if you would like that one. [Laughter.]

I'm prepared. Have speech; will talk.

But I really do look forward to the cooperation we're going to experience from your office. I know that you're an outstanding guy in this town, and it's been a pleasure to work with you these years. And you know in this Committee you have a Committee that sort of breaks down the traditional Republican-Democrat barriers. We work well together. When Mr. Gore was a Member of the Committee, we had a number of cooperative endeavors, and we work well with Chairman Brown and Chairman Boucher, and we will work well with you.

But what we really want is some help. I ask everyone the same thing: help us help you. I like to tell people that I'm from the Legislative Branch of government; I'm here to help you, and they usually smile when I say that.

But the difficulty we have is establishing realistic and sensible priorities——

Dr. Gibbons. Yes.

Mr. Boehlert [continuing]. And I don't mean to be flip about the SSC, but—it's good science; I don't quarrel with that—it's not priority science. I think what we're talking about today is priority science and we've got to get on with it. And we've got to find the dollars to convince our colleagues that we're proceeding in the right direction in the best interest of the country without further indebting our grandchildren.

Dr. Gibbons. I share your concern, and I think; however, discomforting it is, we do have to look very deeply at everything we're doing and make sure that they're constantly tuned in the right direction.

I'd be happy to talk with you about such science projects as SSC when there's more time and perhaps a better occasion, but I would like to point out that on the SSC one thing the Administration is trying to do is to extend the time over which that project takes fruition, and, as a consequence, hopefully be able to not only do a better job of internationalizing what was originally a national program, but also make it less of an impact on the near-term budget.

And it's particularly difficult, as you know, to trade off investments in basic science, on the one hand, from investments in technology or other areas of the economy. It's even difficult within basic science or within the economy.

But I share your concern that we must examine all of these activities of the people through the Federal Government, to constantly assure that we're moving in the right direction, and not wait until we get up against the wall, because when you're up against the wall to make these changes, you have to break things and that's not a good way to go.

Mr. **BOEHLERT**. Yes, I couldn't agree more.

Not to belabor the point, but since you did in responding on the SSC, extending the time limit significantly adds to the overall cost of a project, which incidentally started out in 1985 at a projected cost of $4.5 billion. You can bet your mortgage money we're talking $12 billion right now.

And in terms of internationalizing the project, I almost stood on the front steps of the Capitol last week after Prime Minister Miyazawa departed and said, "There he goes again and he didn't leave the first yen here." So we're not doing very well on internationalizing that project.

Getting back to the high performance computing, when you do report to us in a week or two after you've completed your review and are able to speak more specifically to the legislation, I hope you will pay particular attention to new money versus money you had already programmed in other areas to spend for it. I think that will help us, if we're selling this to our colleagues, if we can point out to them that we're not talking about a lot of new money. In a number of areas you've already projected in your budget that you wanted to spend some of the money that we're talking about spending. So I want to make the job easier. I want to give us an easier sell.

Dr. **GIBBONS**. I appreciate that and I think it is important for us to work with you to make sure people understand that a lot of these so-called FCCSET programs are cross-cuts from the agencies of funds that are embedded in those agencies. It's not new money, but it's money that's being—funds and resources that are being brought together in a new way, and there's a big difference there. So we'll try to work with you to make sure that that's clear.

Mr. **BOEHLERT**. Okay, fine. Thank you very much.

Thank you, Mr. Chairman.

Mr. **BOUCHER**. Thank you very much, Mr. Boehlert.

On that same subject, Dr. Gibbons, let's talk about the quality of this federal investment and why it's really necessary for the government to provide research funding in order to accomplish this development and deployment of the information superhighway. We're targeting applications here that will improve the quality of education and facilitate the establishment of electronic classrooms, so that people in all parts of the Nation will have the opportunity to gain the instruction that is available elsewhere, and that will be a great benefit for people in rural America in particular.

We're targeting applications of the network for medical imaging, so that you can have a variety of diagnosticians located throughout the Nation at different locations simultaneously evaluating a patient's CAT scan or an MRI image. And, of course, that's something that can't be done today. This would be a terrific new interactive use of this network.

We are contemplating the creation of digital libraries, so that the thousands of volumes that are contained today on the shelves of the libraries could be transferred into electronic form and stored in a digital database and then be made readily accessible through an electronic index to any person anywhere in the country—in a classroom, even in a person's own home or business. So that any document could be retrieved very readily and then printed out right there in that person's premises.

These are applications that I personally find to be truly exciting, and I wonder if you would tell me if, in the absence of the federal investment that we're going to make to create this information superhighway, if those applications could come about in the near-term. Is this something that you think the private sector would do on its own if, because of budget constraints or other considerations, we make the decision not to fund this very challenging program?

Dr. GIBBONS. I'd say that if the Federal Government simply stood by, as we have been inclined to in recent years, then we would see a market slowdown in the rate at which this technology would find its way into the marketplace and we would certainly see a very substantial slowdown in the rate at which public sector opportunities could be captured and put into place, into practice.

The first thing one would say is if we don't work on the policies that affect the environment for private investment in these areas, that alone would just nearly tend to shut down the system. It is up to the Nation to help set standards, interoperability, to assure competition in the marketplace. And if we don't provide that kind of seed ground, then, rightly, the investors are going to either have a higher opportunity cost or are going to be nervous about trying to make major investments there. So setting the policy framework is not only an appropriate federal role, it's an essential federal role.

In the area of research and development in the tradition of this Nation, it has been the public investing in its future in exploration and in the ferreting out of new ideas that can enable us to deliver public services more effectively and efficiently, to educate our children more appropriately, the very subjects that you're talking about.

You know, if I go back and say, well, if it had not been for government action, would we have had railroads? We probably would have railroads, but not at the time we had them, that linked our Nation. Would we have highways? Probably so, but not at the time we had them and the early development of our economy with those highways. And I would daresay the same thing for the information system.

Mr. BOUCHER. Well, thank you very much for that very thorough answer. I heartily endorse those comments and think that we should not be embarrassed about spending public funds for legitimate public purposes, where a small investment now can stimulate a much larger reward and result for the Nation's economy and for the quality of life for all of us. And I think that's the mission that we're embarked upon here.

Dr. GIBBONS. And that's just the point, Mr. Chairman, if I might add to that, that what we're talking about in terms of Federal investment is but a drop in the bucket of the total investment that we expect to see called forth in this area, and it's picking those things in which there is strong public interest and high leverage on the public investment that we want to choose.

Mr. BOUCHER. Thank you, Dr. Gibbons. I just have one additional question. We have established in the legislation an external committee existing outside of the ranks of government that will be composed of private sector representatives, as well as the users of this network, in order to make continuing recommendations for the new kinds of applications that should be brought forward from time to time with government support, encouragement, and coordination. Do you believe that that external committee is properly structured as a way to get that kind of advice? And do you think, in particular, that the private sector, the telephone industry, the computer industry, the software development industry, are appropriately represented in terms of the way that that committee is structured? Are you likely to get the kinds of advice from the private sector that would be appropriate in order to make sure that future applications are properly targeted and appropriately recommended?

Dr. GIBBONS. Well, first of all, we firmly believe that a productive interaction between the public sector and the private sector in this, as in other areas, is absolutely essential or we can go off in the wrong direction. The question is, exactly how can that take place in the most fruitful way? We feel that, first of all, we want to be well organized within the Executive Branch, so that we have the family of agencies concerned with this acting as a unit, as a unified group. And, secondly, we want to be able to interact with our corresponding stakeholders in the private sector, and we feel that this is a very important thing to be doing.

We are reviewing the explicit mechanisms for this. We're also looking at some of the other things that are happening already in the private sector, such as the vision work that John Young and others under the Council on Competitiveness are doing in other areas. But we firmly believe that dialog is not only constructive and helpful, but it's actually essential as we move ahead on this in a new form of partnership.

Mr. BOUCHER. Dr. Gibbons, thank you very much for your thoughtful comments on this legislation. We will look forward to working with you as we refine it further and also as we address a large number of other issues of interest to the scientific community, to researchers, and to the users of research results in the United States.

Mr. Boehlert, do you have anything further?

Mr. BOEHLERT. No.

Mr. BOUCHER. Dr. Gibbons, with the subcommittee's thanks, we will dismiss you now——

Dr. GIBBONS. Thank you, sir.

Mr. BOUCHER [continuing]. And turn to our second panel of witnesses.

We welcome now Mr. Thomas Tauke, the Executive Vice President of Government Affairs for NYNEX; Mr. Robert Ewald, the Executive Vice President and General Manager of Supercomputer Operations for Cray Research, Incorporated; Dr. W.B. Barker, the President of BBN Communications; and Dr. Richard Rashid, the Director of Research for the Microsoft Corporation.

Without objections, the prepared written statements of each of these witnesses will be made a part of the record, and we will be pleased to receive the oral summaries of those statements from each of the witnesses and would encourage the witnesses to keep their oral summaries to approximately five minutes, so that we'll have plenty of time for questions with regard to the very interesting testimony that I know we'll receive.

Mr. Tauke, you appear to be prepared, and so we'll be pleased to begin with you this morning.

STATEMENT OF THOMAS J. TAUKE, EXECUTIVE VICE PRESIDENT, GOVERNMENT AFFAIRS, NYNEX, WASHINGTON, DC; ROBERT H. EWALD, EXECUTIVE VICE PRESIDENT AND GENERAL MANAGER, SUPERCOMPUTER OPERATIONS, CRAY RESEARCH, INC., CHIPPEWA FALLS, WI; DR. W.B. BARKER, PRESIDENT, BBN COMMUNICATIONS, CAMBRIDGE, MA; AND DR. RICHARD F. RASHID, DIRECTOR OF RESEARCH, MICROSOFT CORP., REDMOND, WA

Mr. TAUKE. Appearances can sometimes be misleading.

Mr. Chairman, Mr. Boehlert, thank you very much for the opportunity to come here and testify. As you indicated, I have submitted a written statement and I will share a few thoughts with you this morning.

First, I want to congratulate both of you for the legislation that you have introduced. You and your excellent staffs and other Members of Congress have done a very good job, I think, in putting together H.R. 1757. We have moved to the point now where the national research and education network has been defined as a vision, but it now needs to be clarified. This legislation makes policy decisions that move us from NREN as a vision to NREN as reality, and begins to clarify how we get to the place we want to go.

In February, I testified before this subcommittee about what we hoped might be included in this legislation and some ideas we had about public policy in this arena. Subsequent to that, 14 CEOs from the telecommunications industry issued a policy statement which paralleled much of what had been articulated in our February testimony. I am pleased to note that many of the concepts and ideas contained in that policy statement have found their way into H.R. 1757, and that's one of the reasons why we think this legislation is headed in the right direction.

As we think to the future and we attempt to have legislation framed that defines how we develop the National Information Infrastructure, I believe it's important that we understand clearly what the vision of the National Information Infrastructure is. We believe that the National Information Infrastructure will be an integrated network of networks, an integrated network of networks which will provide voice services, data services, and interactive video services that will be accessible to all Americans. Dr. Gibbons and others have outlined the many usages that can be offered over this network and that will enhance the quality of lives of Americans.

But while we share a vision of what we will have and what it will do, there are, I think, there's a lot of confusion about how we're going to get there, how we are going to evolve from the existing infrastructure that's out there into the National Information Infrastructure that we envision. Right now we have a voice-based telephone network. We also have a data-based, if you will, internet. We have other technologies, such as cable, out there. All three of those technology groupings, if you will, are going to be coming together. All three are going to be offering voice, data, interactive multimedia services over their networks, and all will eventually move to the same technology, we believe, in order to deliver those services. But making that evolution occur in a smooth and seamless way is a very difficult public policy challenge, and that's part of the challenge that is being tackled in this legislation.

I might note that in my home state of Iowa the state government has placed a substantial amount of emphasis on the building of a network that connects schools and other facilities into an integrated statewide fiber optic interactive video network. But because the planning was not done ahead of time for the integration of that network into all of these other networks, the state is facing a real challenge right now. You have the opportunity now to set the rules ahead of time for this integration, and that's what should be one of the thrusts of this legislation.

There are two areas where we would direct your attention when it comes to bringing that integration into being. The first is defining the role of government and the second is clarifying some process issues. Defining the role of government is a relatively easy task generally, and we think you've made major steps forward in this legislation. There is also an emerging consensus, we think, about what the role of government is versus the private sector in this area.

But I think it's terrific that the usage of NSFNET has been limited as it has in section 102(d). We aren't saying that it's necessarily precisely the right language or precisely the right time frame, but we believe that it is very important that something similar to section 102(d) be in the legislation.

What is of concern to us is section 102(d) is limited only to the NSFNET backbone, but there is much additional funding in the legislation that provides for the potential building or subsidizing of networks. We believe that what is in 102(d) should be expanded to cover the building and subsidizing of mid-level networks as well, so that we clarify what the role of government is in relation to the building and subsidizing and operation of networks.

The second area is process. It is very important that as this program matures that there is a process in place which allows providers and the users of services, especially the user community, an opportunity to be involved in the many decisions that are going to be made as the integration of these networks becomes a reality.

The Inspector General's report highlights some of the problems that we currently have with the decisionmaking processes, and I commend the chairman for asking for that Inspector General's report. I commend it to the Members if you have not had an opportunity to review it.

Essentially, the Inspector General's report suggests that there—makes a number of recommendations for changes in the process. Generally, we believe those recommendations are heading in the right direction. Because while Congress can establish the vision and define the role of government, it will not make the ongoing day-to-day decisions which implement those decisions. We believe that, therefore, we need a process that is orderly, that is open, and that is accountable, and we believe that you have taken steps in this bill to move us in that direction, but we think more needs to be done.

The program plan that you have in place is certainly a very good idea. It's an idea that will help clarify and define the direction of internet, NREN, and the National Information Infrastructure. It would be useful if there would be greater ability for the user community and other providers and the public at large to comment on the development of that plan and to comment on the plan once it is in place.

We believe that the central planning authority and coordinating authority in OSTP is a giant step in the right direction. And, Mr. Chairman, we hope you will hold fast in trying to bring some central coordination to this program.

It is important that there be some kind of contact point for Congress and the public in the OSTP, again, as you are trying to do in this bill, but there are other steps that could be taken in order to ensure that we have an orderly, open, accountable process. I outlined four options in the written testimony, that I have submitted. We are looking forward to working with you and your staffs to explore other options that are available.

The process itself, which process is used, is not critical, but ensuring that it's open, that it's accountable, and that there is some orderliness to it is very critical if we are going to be able to have a smooth transition to that vision of an integrated network of networks which should constitute our National Information Infrastructure.

Thank you.

[The prepared statement of Mr. Tauke follows:]

STATEMENT OF TOM TAUKE
VICE PRESIDENT, GOVERNMENT AFFAIRS
OF
NYNEX CORPORATION

ON H. R. 1757

THE "HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993"

BEFORE THE SUBCOMMITTEE ON SCIENCE
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

April 27, 1993

STATEMENT OF TOM TAUKE
VICE PRESIDENT, GOVERNMENT AFFAIRS, NYNEX CORPORATION
BEFORE THE SUBCOMMITTEE ON SCIENCE
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

April 27, 1993

Mr. Chairman:

Thank you for the opportunity to testify before this Subcommittee. My name is Tom Tauke and I am Vice President, Government Affairs for NYNEX Corporation. NYNEX is a leader in helping people communicate using information networks and services. The company's Telecommunications Group -- which includes New England Telephone and New York Telephone -- provides voice and data communications services in the northeastern United States. NYNEX Worldwide Services Group provides network and information systems in the United States and in seventy other countries, wireless communications services in the Northeast, and directory publishing worldwide. NYNEX also offers financial services.

This past February, I had the opportunity to testify before this Subcommittee on the future of the telecommunications infrastructure and, particularly, the National Research and Education Network (NREN). On March 23, 1993, the Chief Executive Officers of fourteen major telecommunications companies issued a policy statement on infrastructure development ("CEO Policy Statement"), a copy of which is attached. Since then, the Board of the United States Telephone Association has endorsed the statement. The CEO Policy Statement and my February testimony are consistent, and reflect a unified telecommunications industry position on the nation's infrastructure development.

Mr. Chairman, I congratulate you on the introduction of H. R. 1757, the "High Performance Computing and High Speed Networking Applications Act of 1993" (the "Bill"). The Bill goes far in addressing the concerns we expressed in the CEO Policy Statement and in my February testimony.

Today, I will review the major points of my February statement in light of the Bill, and I will review the portions of the Bill that specifically address the concerns I raised at that time. Finally, I will discuss some of the remaining areas of concern and offer solutions as to how these concerns might be addressed.

FEBRUARY TESTIMONY

My February testimony was intended to assist this Committee in creating a policy framework under which the national telecommunications infrastructure would be developed. I testified that public policy should:

- ensure that all Americans have access to the benefits of the information age by renewing the nation's commitment to universal service;
- encourage competition by promoting the development of interconnected public switched networks to all providers of information;
- encourage innovation in both applications and leading edge technology;
- promote the development of user-friendly applications which will meet specific societal objectives, e.g. improved education and health care; and

- use limited government funds to leverage private investment and achieve appropriate economic and public policy objectives.

These policy goals will provide the framework by which specific action should be taken. It is important for policy makers to articulate a common vision encompassing these goals -- a vision agreed to by government, the telecommunications industry, the computer industry, and affected user groups.

My February testimony also outlined actions government should take to promote this vision and to develop the policy that will guide this vision. NYNEX believes that these principles remain valid and that Government should:

- encourage the continued development of a modern communications infrastructure by taking full advantage of private sector capital and expertise;
- provide resources for the development and deployment of new technology and user-friendly applications;
- provide funds to entities such as schools, research institutions, libraries and health care providers to enable them to meet their communications and information needs and develop programs which emphasize the vast network applications available to users;
- encourage collaboration among government, industry, academia and key user groups;
- foster the development of standards to ensure interconnectivity and efficiency; and
- take the lead in resolving security, privacy and intellectual property issues.

By taking these actions, government will promote the greatest possible use of the communications infrastructure. Government can take advantage of existing infrastructure facilities to promote access through research and direct subsidies to targeted customers -- such as research facilities, schools, health care facilities and libraries -- as well as providing seed money to encourage the development of new applications.

Finally, my February testimony indicated that government should not:

- build or operate commercial communications networks; or
- broadly subsidize general usage of communications networks.

THE BILL

Mr. Chairman, H. R. 1757, which you and seventeen of your colleagues introduced on April 21, 1993, is a solid piece of legislation. I commend you and your staff for the work that went into the Bill and look forward to working with you as this legislation continues to develop.

I am pleased to report to you that H. R. 1757 addresses in large measure many of the concerns that we discussed during the February 2, 1993 hearing. I thank you for that. Specifically, your Bill addresses eight issues we cited as critical to achieving the goals of a national information infrastructure. These issues are: access; applications development; collaboration; leveraging government funds; support for certain end users; standards development; network security and privacy; and restrictions on use of government subsidized networks. Each are discussed below.

1. Access

Section 306 of the Bill addresses network access. Although we have some concerns about this provision's "Connections Program," which I will address later in this testimony, the concept of broad network access is crucial. The Bill creates training programs for teachers, students, librarians, and state and local government personnel on the use of computer networks. Proper training on communications and information network use is essential, for access without training is really no access at all.

2. Application Development

The thrust of the Bill is network application development, which will allow the infrastructure to be used for distance learning, remote medical diagnosis, "tele-commuting" and much more. The Bill would provide seed money for educational, health care, library, and government information application development to make every day life easier and better for all Americans.

3. Collaboration

Collaboration among government, industry, academia and user groups will promote efficiency in the development of the infrastructure, for with collaboration, government will not unintentionally duplicate private sector efforts. The High Performance Computing and Applications Advisory Committee that would be authorized by the amendments to Section 101(b) would replace the High Performance Computing Advisory Committee currently in Section 101(b) of the High Performance Computing Act of 1991 ("HPC Act of 1991"). The advisory committee was one of the few mechanisms, even if limited, in the 1991 law that would have permitted critically needed public participation in the High

Performance Computing Program. As you know, however, even this limited forum for public review was never established.

Under the amended Section 101(b) of the HPC Act of 1991, the advisory committee's role would be expanded to include not only the high performance computing aspects of the law, but the networking and application development aspects as well. Once established pursuant to the amended Section 101(b), this advisory committee has the potential to provide interested parties, like NYNEX, a forum to participate in the development of the various aspects of the High Performance Computing Program, such as the National Research and Education Network Program and the Plan for Computing and Networking Applications. To improve the prospects that it will achieve these objectives, later in my testimony I will note some suggestions for improving the advisory committee provisions.

Section 5 of H. R. 1757, which would amend Section 102(b) of the HPC Act of 1991, provides for public and private cooperation in the development and deployment of experimental test bed networks. NYNEX is eager to participate in this aspect of the program. As I stated last February, NYNEX is already involved in several advanced networking projects, including one called NYNET. Using the public telephone network, NYNET will link Cornell University, Syracuse University, the Museum of Science and Technology in Syracuse, New York Telephone, and Rome labs. Our experience with this multimedia, fiber-optic gigabit network, and other advanced networking projects, will be beneficial to the development and deployment of the experimental test bed networks and, ultimately, to the deployment of high speed commercial networks. These projects demonstrate the type of collaboration that would be furthered by the Bill.

4. Leveraging Government Funds

Section 102(b) of the HPC Act of 1991, as amended by Section 5 of the Bill, also would provide groundwork for leveraging Federal funds. It requires that experimental test bed networks be developed by purchasing transmission and network services from vendors whenever feasible. As I have stated, government need not spend money on building communications networks that already exist. It is more efficient to purchase services where feasible -- not create duplicative networks. Finally, collaborative cost sharing and partnerships between government and industry on applications programs is expressively provided for in Section 302(c) of the HPC Act of 1991, as it would be amended by Section 3 of the Bill.

5. Support for Certain End-Users

Another important role for government is to provide direct support to selected end users who need network access. Schools, health care facilities, and local governments are appropriate targets for support. Section 308 of the HPC Act of 1991, as it would be amended by Section 3 of the Bill, provides assistance for elementary and secondary schools to connect to the Internet. Also, Section 102(a), as it would be amended by Section 5 of the Bill, provides for support of researchers, educators and students to connect to the Internet.

While we encourage government help in connecting end users to communications networks, we do not believe that connections should be limited to the Internet as it exists and is understood today, as there are other available communications and information networks. Public policy should not identify Internet as the only platform from which the national information infrastructure will be achieved. If it did, the future of the public network would be bleak.

6. Standards Development

Section 307 of the HPC Act of 1991, as it would be amended by Section 3 of the Bill, contains important provisions on the development of simplified interfaces for Internet access, as well as provisions for Internet security and privacy. Also, it is important to note that Section 204(a)(1) of the HPC Act of 1991 requires that the National Institute of Standards and Technology promote standards for interoperability of high speed computing systems in networks and for common use interfaces to the system. In practice, this means working with voluntary industry standards bodies such as Committee T1 of the American National Standards Institute that will adopt and promulgate appropriate standards. These standards are critical to achieving a truly seamless high speed, advanced telecommunications infrastructure.

7. Network Security and Privacy

Under Section 3 of the Bill, Section 307(b) of the HPC Act of 1991 would be amended to require that the Plan for Computing and Networking Applications specify research programs needed to ensure the privacy and security of information transmitted over the Internet. The benefits from this research should be made available to all providers of communication network services. Privacy and security are critical to many users of network-based applications. Users of the infrastructure must have confidence that the security and privacy of transmissions will not be compromised.

8. Restriction on Use of Government Subsidized Networks

Finally, the Bill has laid a foundation for prohibiting general usage of government-subsidized networks. Both the CEO Policy Statement and my February testimony called for the establishment of "Experimental Networks" and "Production Networks." The Experimental Networks should consist of: government-supported test beds for leading edge technology and applications and high performance national test beds, such as supercomputer interconnection. These networks should be used only for traffic relating to the experimental goals of the specific network and by researchers who need to perform applications that require the advanced technological capabilities of these networks which cannot be performed on commercially available networks. All other networks would be Production Networks, the building and operation of which should not be directly subsidized. Any usage outside of these specified parameters listed above should be over these commercially available Production Networks.

The basic concept of Experimental Networks is captured in Section 5 of the Bill, which would amend Section 102 of the HPC Act of 1991 as it relates to the Experimental Test Bed Networks. These networks may be subsidized by the Federal government, and if so subsidized, would be subject to the use limitations contained in Section 102(d) of the HPC Act of 1991 as amended by the Bill. Consequently, these test bed networks are not to be used to provide services that could otherwise be provided over commercial networks.

AREAS OF CONCERN

We view this legislation as a key building block in the establishment of a national policy for the development of the information infrastructure. The decisions made by policymakers pursuant to this legislation will determine: a) whether or not the High Performance Computing programs are integrated into a network of networks which becomes the National Information Infrastructure, and b) how smoothly and promptly the integration occurs between networks built on the foundation of the public switched voice services and those networks built around the foundation of the data services offered on Internet. Therefore, we have two areas of concern which should be addressed in the Bill.

First, we are concerned about the absence of a process in which government agencies are accountable for decisions relating to the development of High Performance Computing Programs. Second, we are concerned about the role of government in building and operating networks which provide commercial services and compete with private industry.

1. Process

Without regard to whether the substantive rules regarding government funding and operation of networks are further perfected, the Bill should be revised to make certain that the rules that are put into place are followed. Absent a process or procedure which clearly delineates how decisions are made, how recommendations from interested parties are to be considered, and what specific recourse is available for parties affected by government decisions, there simply is no way for public policy makers or interested parties to make certain the substantive requirements established by Congress and any other applicable rules are followed.

That is not to suggest that pervasive regulation is appropriate. Voluntary associations of commercial enterprises currently are quite successful in self-governing in circumstances in which cooperation is appropriate. For example, the standards for interoperability have long been established in this country by voluntary standards bodies which operate under the American National Standards Institute due process rules.

Unfortunately, with respect to decisions regarding the national information infrastructure, cooperative and voluntary process simply may not work. This is because firms are competing for both private and public sector business, and the necessary decisions frequently would affect the business that competing firms can expect to secure. Thus, we are faced with the problem of ensuring a meaningful chance for public participation in the process in order to assure public policy makers that funds are appropriately spent, while resisting the imposition of unnecessary rules and regulations that may impede the delivery of service to customers.

To illustrate our concern, consider that Section 102 of the HPC Act of 1991 requires various government agencies to support the NREN Program. These agencies include the National Science Foundation, the Department of Commerce, the Department of Defense, the Department of Energy, National Aeronautics and Space Administration. In some cases that is because the decision may not rise to a rulemaking or other agency action subject to the Administrative Procedure Act (5 U.S.C. Section 551 et seq.) ("APA"). In other cases, no coordinated decision making has been undertaken. In either case the result is the same. Public funds are expended and public policy is formed without adequate public review and consultation.

We have four suggestions that address this problem. Each is addressed below.

a. Strengthen Advisory Committee Review

One procedural device currently included in the Bill is the advisory committee I discussed earlier. We believe that the committee should be retained in the Bill, but with some modifications. The advisory committee should be specifically required to consider whether proposed agency actions comply with the principle of averting subsidized competition with private facilities and to advise agencies accordingly. We also believe that the committee should be required to hold periodic public meetings to receive testimony, something that is not assured under the Federal Advisory Committee Act (5 U.S.C.App. 2, sec. 1, et seq.).

However, the advisory committee is not the government. So, what really needs to be done is to ensure that the government itself, not just its advisory committee, has a good process as well as clear governing criteria.

b. Use Administrative Procedure Act

One possible model may be the APA. We say model because we understand that a number of the program and funding decisions that have to be made to advance the High Performance Computing Program may not be considered rules or other agency action subject to APA requirements for notice, comment, and judicial review. What we need are provisions which do not become obstacles to the High Performance Computing Program but do ensure that key decisions, with long-term consequences for the public, are noticed and subject to public debate before they are made. This could be done by coming up with a description of the kind of action which should be subject to notice, comment and judicial review and then writing that requirement into the Bill. Clear criteria in the Bill would provide direction and diminish the possibility of future disagreements.

c. Use Reports to Congress

Section 3 of the Bill, as it would amend Section 302(a) of the HPC Act of 1991, requires reports to Congress. The Bill should require that these reports contain explanations about the steps that have been taken to ensure 1) that actions taken under the Act are moving the nation toward the goal of an integrated network of networks referred to as the National Information Infrastructure, and 2) that Federal tax funds have not inappropriately supported the building of networks that compete with privately funded communication facilities. Two positive benefits would result. First, the agencies would undoubtedly give greater focus to these objectives in administering the program. Second, Congress would be particularly alerted to developments bearing on these matters.

d. Require Progress Review by Congress

In addition to the periodic reports to Congress required by Section 3 of the Bill, the Bill could require progress reviews by this Committee and make subsequent funding contingent on a finding that actions taken under the HPC Program were consistent with the intent of the legislation. We would support similar legislation here, particularly if other procedural safeguards are not created.[1]

2. Government Role in Building and Operating Networks

The Bill should clearly provide that the goverment should not build or operate networks which provide commerical services and thereby compete with private industry. This could be accomplished by ensuring that all Federal funds expended for the building and operation of networks under the HPC Act of 1991 as originally enacted and as amended by the Bill are subject to the restrictions contained in Section 5 of the Bill. As currently drafted, Section 5 of the Bill would affect only the National Research and Education Network Program as described in Section 102 of the HPC Act of 1991 as it would be amended by the Bill.

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[1] Such an approach has precedent. For example, Congress directed the Secretary of Transportation in Section 1006 of the Intermodal Surface Transportation Efficiency Act of 1991, Pub.L. 102-240, to propose highways for inclusion in a new National Highway System ("NHS"). Congress further provided that the Secretary of Transportation should submit the proposed NHS map to Congress for approval by legislation, and that, unless authorizing legislation was passed by a certain date, certain funds could not be spent. 23 U.S.C. 103(b)(3)(B).

This problem arises most directly in Section 306 of the Bill. Under Section 306(a)(1), NSF is to foster the creation of local networks. While NYNEX supports the development of local networks, we do not believe that taxpayer money should be used by local or state governments to build their own private networks which could then also compete with private sector networks for commercial traffic. Instead, government should foster the creation of local networks by encouraging communities to work with commercial network providers to provide the required services directly to Federal, state and local governments.

The legislation should therefore make clear that Section 306 does not give NSF authorization to compete with the private sector by subsidizing network building and operation. The same issue arises in other areas of the HPC Act of 1991, such as Sections 201(a)(4) and 203(a)(4), and may arise elsewhere in the HPC Act of 1991 and in the Bill. Applying restrictions similar to those contained in Section 5 of the Bill to the entire HPC Act of 1991, as amended, is one way to resolve this concern. Other ways certainly are possible. In any event, based on some of the provisions included in the Bill, including Section 5, we are hopeful that the Committee agrees with this concept, and we plan to work with staff to develop appropriate safeguarding language for inclusion in the Bill.

CONCLUSION

Mr. Chairman, your bill will help America prepare for the information age. It will foster the application development needed to help promote infrastructure modernization. The Bill takes great strides in addressing NYNEX's concerns and those expressed in the CEO Policy Statement, and we thank you for that. Adoption of the recommendations contained in this testimony would, we believe, further improve the Bill.

I appreciate this opportunity to once again address this Subcommittee, and I look forward to working with you as this legislation moves forward.

William L. Weiss
Chairman and CEO
Ameritech Corp.

Robert E. Allen
Chairman and CEO
American Telephone and Telegraph, Co.

Raymond W. Smith
Chairman and CEO
Bell Atlantic Corp.

George H. Heilmeier
President and CEO
Bellcore

John L. Clendenin
Chairman of the Board and CEO
BellSouth Corp.

Dwight H. Hibbard
Chairman and CEO
Cincinnati Bell Inc.

Charles R. Lee
Chairman and CEO
GTE Corp.

Bert C. Roberts
Chairman and CEO
MCI Communications Corp.

William C. Ferguson
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NYNEX Corp.

Sam L. Ginn
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Edward E. Whitacre, Jr.
Chairman of the Board and CEO
Southwestern Bell Corp.

William Esrey
Chairman and CEO
Sprint Corp.

Daniel J. Miglio
President and CEO
The Southern New England Telephone Company

Richard McCormick
Chairman and CEO
U S WEST, Inc.

POLICY STATEMENT

The telecommunications industry, as represented by the largest public carriers who provide telecommunications services to the majority of Americans, strongly supports the initiatives outlined in the Clinton Administration's Technology Initiative paper of February 22, 1993. We have developed a set of principles which are consistent with the Administration's vision and which articulate the role of government and industry in fostering information networks. We suggest that the Administration and Congress adopt these principles as a framework for cooperation among federal, state and local governments, key user communities, academia, and the private sector.

We look forward to the challenge of evolving information networks to meet urgent societal needs, spurring economic growth, and strengthening America's competitive position in the global economy.

POLICY STATEMENT

1 The High Performance Computing and Communications (HPCC) vision should be expanded to foster the emergence of services and applications that will serve the urgent societal needs of a broad range of users and industries, such as K-16 education, health care delivery and cost containment, manufacturing productivity and job creation, and the general public through telecommuting and access to libraries and other data bases. This imperative is shared with the recommendations of the Computer Systems Policy Project (CSPP).

2 This expanded vision can be most effectively served by a target structure comprised of separate Experimental and Production Networks. Experimental Networks should consist of government supported testbeds (for example, the Gigabit testbeds) and high performance national testbeds (for example, interconnecting major supercomputer research sites) for leading edge networking technology and applications requiring such technology. Experimental Networks supported by the government should be used only:

a) To carry traffic directly related to the experimental goals of these networks, and,

b) By those researchers who need to perform applications that require the advanced technological capabilities of these networks, and which cannot be performed on Production Networks.

These Experimental Networks will be developed by partnerships among government, academia, private industry and target user communities. These partnerships, which can build upon the long and successful collaboration between industry, academia and government, can leverage the government's limited resources to maximize social return.

Production Networks should consist of present and future commercially available communications networks. Production Networks would:

a) Be built, managed and operated by multiple providers from the private sector;

b) Provide a vehicle for technology transfer from their experimental counterparts;

c) Offer commercial networking capabilities to the business and residential population; and

d) Serve all users, including the Research and Education Community, for those applications that can be supported by commercially available network services.

The government, private sector and key user communities should jointly implement transition steps to achieve this target structure.

(continued)

3 The government should encourage maximum interconnectivity and interoperability among Production Networks as an important goal of public policy.

4 The following four activities should be supported by the government and given the highest priority for achieving broad societal benefits:

a) Research into applications and services that will provide for the urgent needs of the broad range of users in K-16 education, health care and industries critical for U.S. competitiveness.

b) Research into user-friendly access and use of the networks to promote broad utilization by all members of society.

c) Direct subsidies to the Research and Education communities to support their access to and use of Production Networks.

d) Technical development of the Experimental Networks, including continued support of the Research and Education community's contributions in developing these networks.

5 Full consideration should be given to the present and future developments of the computer, telecommunications, information and related industries when planning, designing, and implementing the technology and standards for the Experimental Networks. Giving full consideration to the developments in all these industries will help ensure the maximum transfer of the best and most effective technology from the Experimental to the Production Networks.

6 Decision making processes relative to government programs and associated funding should be open to the target user community, including K-16 educational institutions, libraries, the health care industry, and industries critical to U.S. competitiveness. The decision-making process should also include representation from the computer, telecommunications, information and related industries.

7 The government and industry should strive for a framework that promotes fair and open competition, encourages innovation, and allows for effective participation among all participants and industries. This would allow all participants in the Production Networks to contribute effectively towards the evolution of the national information infrastructure to satisfy future needs.

Key Benefits

The set of principles embodied in this public policy statement provide a framework for continued development, growth and improvement of information networking capabilities in an ongoing economically sustainable way. Additional benefits include:

- Increased private sector investment in and continued development of a national information infrastructure will result from the government serving as a catalyst. Partnerships among the government, academia, industry and key user communities will focus on development of experimental technologies and leveraging limited government funds. The transfer of technology from Experimental to Production Networks will provide new capabilities to users, meet their expanding needs and increase industry's investment in the infrastructure.
- Alternative visions of the national information infrastructure can be integrated into a common vision of an infrastructure which provides interactive multi-media and other advanced networking capabilities to all Americans.
- Industry's incentive to invest in infrastructure will remain strong because there will be no government subsidies to Production Networks, and no commercial services will be provided on Experimental Networks.
- Selected end-user communities will be provided support for access to and use of networks and information through government funding. Supporting end user communities represents a shift of emphasis from the government's direct support of networks. These funds, predominantly grants, would be carefully targeted by the government to meet urgent societal needs by those end-user communities which otherwise could not afford to take advantage of the benefits that the infrastructure can provide.
- Ever increasing reliability and substantially improved operating standards will become available in commercial networks such that they can be matched to the critical requirements of end users.
- Alternative network suppliers will be able to interconnect seamlessly with each other resulting in a wide array of competitive choices that will spur innovation and result in competitive prices to end users.

Mr. **Boucher**. Thank you very much, Mr. Tauke. We'll have some questions of you, but pending that, we'll recognize our other witnesses for their comments as well.

Mr. Ewald?

Mr. **Ewald**. Thank you, Mr. Chairman and Mr. Boehlert. I'm Bob Ewald, and I run Cray's Supercomputer business. I'm General Manager of Supercomputing Operations and also an Executive Vice President of the corporation. However, today I am here representing the Computer Systems Policy Project, or the CSPP, and that is a group of 13 Chief Executives of the Nation's computer systems industry. And that group works together to Make public policy statements or create public policy statements on issues of trade and technology and other issues facing the Nation. And, in fact, I think you have received a report previously, the CSPP perspectives on the National Information Infrastructure, CSPP's vision and recommendations for action.

So thank you again for the opportunity to appear before the Subcommittee, and we are—CSPP—is pleased to support H.R. 1757, and I have submitted written testimony, and, thankfully, I won't read it today, but would just hit some of the key points that we have. And really there are four key points that we wanted to make in the testimony today.

First, support for H.R. 1757; second, the importance of applications; thirdly, focus, the focus on results that's indicated in the bill; and then, fourth, desire to strengthen management of the whole HPCC and NII effort that we have heard about before.

First, H.R. 1757 is excellent, in our view, in moving ahead to accelerate the deployment of NII, integrate the high performance computing and communications initiative with NII. So we support it very strongly. We are ready to help as we can in terms of being on advisory committees or providing advice of one kind or another, and then actually moving into the implementation. So, again, the computer systems industry thinks it's an excellent bill, and we stand ready to help and support it.

Secondly, we like the focus on applications. And, as we have heard earlier this morning—and I'll give a little example—we think that really is the key to implementing and making the NII and the HPCC useful. Without the applications, we really won't have anything other than a network, which is not particularly useful to real people, to industry, to the government, and to the private sector as well. So we really support the focus on applications, and we are also pleased to see that some of the CSPP recommendations of the past were included in the bill concerning the focus on applications.

Thirdly, focus on results, the real key again will be to get applications and then to be able to deliver the results of those applications to people who can make use of them, whether they be private citizens, industry, or government. Though there are parts of the bill which are research efforts, the real key here, again, is delivering real results to the end customers. And so in that light, we support strongly the use of computational tools that exist, of networks that exist, of workstations that exist, and trying to take advantage of the software that exists to, again, get moving quickly to be able to deliver results as quickly as we can.

Fourth, improved management, we believe that the HPCC and the National Information Infrastructure will need strong management. We believe that the coordination role that has been outlined in the past is a good way to get started perhaps, but really believe in strengthening the management. And, again, we're pleased to see the steps that you have proposed in the legislation to accomplish that.

We further recommend that we establish five-year goals for the program, that we set annual objectives, that we seek private sector input, as you have suggested, and that we really review the program on an ongoing basis and measure it for the results that we have talked about; and, again, have seen good steps in the legislation which call for the strengthening of the management of the activity.

Let me give you an example of something that's been in the press just in the last two or three weeks, as an example of what we believe high performance computing and the National Information Infrastructure, and the ability to deliver that computing to people, can do for us. And this is a problem of national importance, and this example deals with health care.

And we read last week, I think it was, that the Center for Disease Control and Prevention identified there are roughly 4 million births in the U.S. in a year, and of those, about 1 million are Caesarian sections. I think that the U.S. numbers are about the second highest of the countries surveyed in terms of the number of Caesarian births, and the Center for Disease Control estimated that if we could reduce the number of Caesarian births from about 25 percent today down to 15 percent in the future, we could save about a billion dollars a year in health care costs alone, both hospital as well as physician costs, so about a billion dollars a year. So if we were able to combine that desire and that policy direction that we will have in front of us as a nation with software and hardware capability, to be able to better model the childbirth process, we could imagine that we could take some steps fairly quickly to move in that direction.

And, coincidentally, in Germany within the last month it has been reported that using one of our Cray systems and using high-powered graphical workstations and a network, that a team of researchers and physicians in Germany have been able to create a model of the birthing process, the human birthing process. And they do that by taking digital x-rays and combining those with the results of ultrasound readings that have been taken in the doctor's office, in the hospital, and to create really a digital image of both the mother and the child, and then they are able, using again the simulation tools with the high performance computers and the workstations and the networks, they're able to actually simulate the birthing process, the child moving through the birth canal and figure out the effects on both the child, as well as on the mother, and well in advance of the actual birth date are able to predict the effects and avoid complications.

So better predictive measure in terms of understanding how and when a more expensive Caesarian section might be needed and when it might not be needed. So, again, an example here of combining an application and creating a simulation using the supercomputers, network, high performance workstation, to be able then to provide information like this to a doctor or a team of doctors before they actually need it, so that they can make better decisions, thus saving money, and, most importantly, though, giving better treatment to both the mother and the child as the child is being born.

So what we see are that the combination of high performance computing, the National Information Infrastructure, with the combination of those, we can create super–CAT scan systems, which this might be an example, all over the country. We can also use the same tools to create kind of a time machine so that we can go 50 years or 100 years into the future and see the impacts on the environment, what's happening with the ozone layer, what about carbon dioxide heating of the atmosphere, and all the rest. We can also use these tools as a microscope to study the effects of viruses. We can create new drugs with these tools, and we can create artificial hearts, and on and on and on and on. So we believe that these tools, high performance computing and NII combined, really create a terrific simulation tool that we can use to address problems of importance to the Nation.

So, in summary, CSPP and the computer systems industry strongly support H.R. 1757. We believe, again, the keys are applications, focusing on results, and strengthening the management of the activities. So on behalf of CSPP, we are pleased again to be able to support the legislation. We're looking forward to working with you, Mr. Chairman and Mr. Boehlert, in working on the legislation and supporting it and the further evolution of the NII, and to be able to create—put these tools together to deliver on the promise for improving the quality of life and enhancing our global competitiveness.

So thank you very much.

[The prepared statement of Mr. Ewald follows:]

STATEMENT OF

Robert Ewald
Executive Vice President
and
General Manager, Supercomputer Operations
Cray Research, Inc.

On Behalf of The Computer Systems Policy Project

HEARING ON THE HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993

Before the Subcommittee on Science
of the House Committee on Science, Space and Technology
April 27, 1993

Mr. Chairman and Members of the Subcommittee, my name is Robert Ewald. I am Executive Vice President of Cray Research, Inc. and General Manager, Supercomputer Operations. Today I am here representing the Computer Systems Policy Project (CSPP). CSPP's members include the chief executives of Apple, AT&T, Compaq, Control Data Systems, Cray Research, Data General, Digital Equipment, Hewlett-Packard, IBM, Silicon Graphics, Sun Microsystems, Tandem, and Unisys. The CSPP CEOs work together to develop and advocate public policy positions on trade and technology issues that affect their industry, all high technology industries, and the nation.

Thank you for the opportunity to appear in support of your bill, H.R. 1757, the High Performance Computing and High Speed Networking Applications Act of 1993. CSPP commends you for your leadership in developing this legislation to advance the U.S. high performance computing and communications infrastructure.

Today, I want to focus on four areas: 1) how H.R. 1757 will accelerate the deployment of the National Information Infrastructure; 2) CSPP's vision for the NII; 3) the importance of a private sector-government partnership to deliver the NII; and 4) applications where the NII will be especially beneficial.

1. H.R. 1757 Will Accelerate Deployment of the Infrastructure

CSPP strongly supports H.R. 1757 because it will speed the development and enhancement of the information infrastructure by advancing research and stimulating the development of applications for networking, software and computing technologies. In particular, we support the authorization of funds for demonstration projects that focus on health care, education, accessing government information, and digital libraries. We recognize that manufacturing is covered in separate legislation, but would like to emphasize the importance of information technologies to manufacturing, as described later in this statement.

Demonstration projects, such as those authorized by H.R. 1757, are essential for several reasons:

- to demonstrate the application of NII technologies in new areas and the benefits they will make possible, such as the cost savings that may be achieved in the management of health care data;

- to accelerate the development of standards;

- to address the problems of developing and managing a large-scale ubiquitous system with many diverse users; and

- to bring together researchers from industry, government, academia, and the user communities in the development of solutions to difficult technology challenges.

We especially appreciate the inclusion in H.R. 1757 of several provisions in response to previous suggestions by CSPP, such as:

- including funds for research required to support networked applications, including network security and privacy and ease of network use through advanced human/computer interfaces;

- requiring the establishment of goals and priorities for the applications program and regular reports on progress in implementing the computing and networking applications plan; and

- encouraging partnerships among participating federal departments and agencies and with the private sector.

America's standard of living is the world's best, and we have much to be proud of in our achievements as a country. However, we cannot be complacent. The United States is currently the world leader in computing and communications technologies, and an enhanced national information infrastructure will put our information technology advantage to work for all Americans. Mr. Chairman, your bill, by expanding the High Performance Computing Act of 1991 to include important application areas, will provide a solid foundation for the information infrastructure of the future. We at CSPP look forward to working with you to make the Information Age a reality.

2. CSPP's NII Vision

CSPP appreciates the effort and attention the Administration and the Congress have devoted to the vision we articulated in our January 1993 report, Perspectives on the National Information Infrastructure: CSPP's Vision and Recommendations for Action. In CSPP's vision, an enhanced NII will allow people -- young and old, in rural areas and in cities -- to access information and communicate with one another easily and securely, in any medium or combination of media -- voice, data, image, video, or multimedia -- any time, anywhere, in a cost-effective manner.

The National Information Infrastructure is far more than an electronic superhighway. In CSPP's vision, the NII integrates four essential and equally important elements:

1) interconnected and interoperable, commercially provided communications networks that carry voice, data, video, broadcast, and cellular traffic;
2) computers and information appliances, including mobile devices, ranging from telephones and fax machines to servers, high performance computers, and supercomputers;
3) information resources, such as databases, applications, electronic libraries, printed materials, videos, and software agents; and
4) the people who build, operate, and use all of the above to create a whole new way of learning, working, and interacting with others.

This vision is attainable. In fact, major components and elements of the information infrastructure of the 21st Century are in place, or will be in the near term. The competitive market has been successful in delivering a great range of products and services for consumers to use and should continue to be the primary driver of new technologies for the NII.

But challenges are growing. Technology is evolving at an ever increasing pace. Some critical technologies, with long research cycles, are just too expensive for a single company to invest in. H.R. 1757 will address this problem by helping to bridge the gap through investments in research and technology demonstration projects.

3. Government and Industry as Partners

While the private sector will build the NII, including the networks, computers, services, and applications, the government has a critical role to play. In CSPP's view, that role includes:

- leading the development, in partnership with industry, academia, users, and other stakeholders, of a national vision of the enhanced NII;

- investing in research on precompetitive technologies and demonstration projects and supporting technology transfer;
- making appropriate government information easily accessible to the public via electronic networks;
- implementing a political and regulatory environment that encourages the development of new technologies and enables competitive markets;
- supporting and adopting industry-developed interoperability standards; and
- coordinating public and private action to address complex policy issues, such as access to the NII, privacy, security, carrier liability, intellectual property, and affordability.

Mr. Chairman, H.R. 1757 is an important step in addressing the research and technology challenges of the NII. It builds on the foundation created by the High Performance Computing and Communications Program. The HPCC program is a significant and critical undertaking; CSPP believes it should remain a national research priority. The goal of the HPCC Program should be, as it is with the NII, to stimulate the development of the full range of promising technologies, not just a select few. In both the underlying HPCC Program and the new applications program, market forces should be permitted to determine which technologies succeed, rather than trying to anticipate market trends.

4. NII Applications

CSPP's vision focuses on the needs of users of technology. Technology must serve the end users, by making their lives better, more fulfilling, and more productive. The NII does this by putting information technology to work for all citizens who want and need access to information, work, health care, education, job training, and entertainment. In our January, 1993 paper, Perspectives on the National Information Infrastructure, we described some of the improvements the nation may be able to achieve through an NII in health care, education, manufacturing, and access to government information.

Health Care: Today, America is facing a national challenge to improve the delivery of healthcare while reducing costs. An NII will offer new opportunities to improve the quality of and access to healthcare for Americans, while reducing costs by: improving management of health care-related information; streamlining the processing of insurance claims through electronic payment and reimbursement; improving access to medical data and patient medical histories by healthcare professionals; enabling residents of rural areas and inner cities to enjoy the benefits of the latest medical technologies and expert opinions without leaving their home towns; and providing individuals in their homes with information on self-care and healthy lifestyle practices to better manage their own health. These improvements in quality, access, and cost can be achieved through: computerized patient records available to authorized medical professionals on-line; medical collaboration and patient consultations over long distances through telemedicine; better access by medical professionals and consumers to outcomes data; and increased use of high performance computing techniques to improve surgical results.

H.R. 1757, by funding the development of applications in clinical information systems, delivery of health care information to the public, and health care services delivery systems, will accelerate the development and deployment of the technologies we need to make the most effective and efficient use of our nation's health care resources.

Education: An enhanced NII will be an essential tool for meeting the education challenges of the future. To ensure a secure and prosperous future, Americans must be able to take advantage of the nation's rich knowledge resources. The workforce requirements of the future will increasingly require people to be able to learn new skills to adapt to changing job requirements and new technologies. We will increasingly have to use knowledge and information to make decisions. Advanced computing and communications technologies, through the NII, can help provide individuals with the skills they will need for lifelong learning in a high wage, information-based economy of the future.

By extending America's lead in computing and communications technologies to education services in schools, communities, work places, and homes, we can bring information, knowledge, and expertise to all Americans, when and where they need it, through a variety of media and in forms in which they can use it. A national information infrastructure will create an enormous range of education and lifelong learning applications, such as on-line job training libraries; multimedia electronic libraries for students of all ages; virtual laboratories and field trips to exotic and educational locations, without leaving the classroom; and new methods for interactive, collaborative learning.

Section 308 of H.R. 1757 will help accelerate the development and deployment of these new lifelong learning applications by demonstrating the educational value of using high performance computing and advanced communications; developing new technologies for teacher training and informal education; and connecting elementary and secondary schools to national communications networks.

Access to Government Information: An information infrastructure could provide federal, state, and local governments with a system to better serve their citizens while reducing the cost of providing those services. Through a national information infrastructure, public information would be easily available and accessible to all citizens. People would have ready access to the most up to date information about their entitlement to health, education, housing, and social security benefits. Citizens could, for example, use the infrastructure to register to vote, renew their drivers licenses, and pay their taxes.

CSPP is pleased that H.R. 1757 authorizes funds for demonstration projects to speed the development and application of high performance computing and networking technologies to improve public access to information generated by Federal state and local governments.

Intelligent Manufacturing: Increasingly, to stay competitive, companies of all sizes must be able to respond rapidly to customer demands for high-quality products at low cost. This requires manufacturing and design processes that are highly efficient and flexible to enable the shortest possible design, development, and production times. Companies able to adapt and apply the latest computing, information, and communications technologies to their manufacturing processes will have an advantage over their less innovative competitors in the future. The challenge, therefore, is to develop, deploy and apply the technologies for a manufacturing infrastructure that incorporates computing and communications technologies to support integrated development, engineering, and manufacturing processes, and to enable applications such as concurrent and distributed design, engineering and manufacturing; electronic commerce; and virtual design and manufacturing.

Conclusion

A clearly defined and coherent vision shared by the private sector and public policy makers is needed to guide the development of an integrated and interoperable NII. This vision calls for shared responsibility. The private sector should develop and deploy the infrastructure, guided by the forces of a free and open market. For its part, the federal government can accelerate the NII implementation by acting as a catalyst and a coordinator; by funding research and demonstrations of applications, as H.R. 1757 does; and by providing a level playing field for all promising technologies in which users are free to purchase the technologies, products, and applications that best meet their needs.

Beyond the scope of H.R. 1757, additional work can be done by both the private and public sectors. The federal government should work, in partnership with the private sector, to address the difficult policy issues that could slow the deployment and use of the NII, such as access to the NII; freedom of expression in the NII; privacy, security, and confidentiality of communications and data; affordability; protection of intellectual property; regulatory barriers to the deployment of new technologies; interoperability; opportunities for competition by service providers and carrier liability.

Most of the work for achieving an enhanced NII must be done by the private sector. CSPP members will continue their investments to develop and deploy the NII, including:

- deployment of interoperable communications networks;
- development of on-line databases and applications;
- development of easy to use computers and information appliances; and
- training people to design, develop, and use the various elements of the infrastructure.

We will also continue to invest in independent and collaborative research and development efforts on NII technologies and new products and services; reach out to other industries and user groups likely to benefit from the applications made possible through an NII; participate in pilot projects; and work with the federal government to develop specific examples of accomplishable goals for an NII, with concrete milestones.

Thank you for this opportunity to present the views of CSPP on H.R. 1757. We look forward to working closely with you, Mr. Chairman, the subcommittee, and with the Administration and other members of the private sector, to further the evolution of the NII, and to deliver upon its promise for improving quality of life and enhancing our global competitiveness for the 21st Century.

SUMMARY OF STATEMENT OF
Robert Ewald
Executive Vice President
and
General Manager, Supercomputer Operations
Cray Research, Inc.

On Behalf of The Computer Systems Policy Project

HEARING ON THE HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993

Before the Subcommittee on Science
of the House Committee on Science, Space and Technology
April 27, 1993

H.R. 1757 will speed the development and enhancement of the information infrastructure by advancing research and stimulating the development of new applications of networking, software and computing technologies. In particular, the Computer Systems Policy Project (CSPP) supports the authorization of funds for demonstration projects that focus on health care, education, accessing government information, and digital libraries.

Demonstration projects are essential to demonstrate the application of NII technologies in new areas and the benefits they will make possible, such as the cost savings that may be achieved in the management of health care data; to accelerate the development of standards; to address the problems of developing and managing a large-scale ubiquitous system with many diverse users; and to bring together researchers from industry, government, academia, and the user communities in the development of solutions to difficult technology challenges.

We especially appreciate the inclusion in H.R. 1757 of several provisions in response to previous suggestions by CSPP, such as including funds for research required to support networked applications; requiring the establishment of goals and priorities for the applications program and regular reports on progress in implementing the computing and networking applications plan; and encouraging partnerships among participating federal departments and agencies and with the private sector.

In CSPP's vision, the NII integrates four essential and equally important elements:

1) interconnected and interoperable, commercially provided communications networks;
2) computers and information appliances;
3) information resources; and

4) people.

H.R. 1757 will accelerate attaining this vision through government-private sector partnerships to invest in research and technology demonstration projects.

While the private sector will build the NII, including the networks, computers, services, and applications, the federal government has an important role as a leader, catalyst, and policy coordinator.

Finally, as we work to enhance the NII, we must focus on the needs of users of technology. Technology must serve the end users, by making their lives better, more fulfilling, and more productive. H.R. 1757 does this by accelerating the development of technologies that will make new applications possible in health care, education, digital libraries, and access to government information.

Mr. BOUCHER. Thank you very much, Mr. Ewald, for that statement of vision and for opportunities that we can realize from the deployment of the information superhighway.

Dr. Barker?

Dr. BARKER. Thank you very much, Mr. Chairman and Mr. Boehlert. I am very pleased and honored to have the opportunity to talk to you today, to share my views on what I think is very important legislation.

My name is Ben Barker. I am president of BBN Communications and a Senior Vice President of its parent, Bolt Beranek and Newman, Inc.

BBN has been at the forefront of high performance communications and parallel processing computers since their inception nearly 25 years ago. I was personally responsible for the installation of the world's first packet switch back in 1969, and I did my doctoral work on the architectural design of Pluribus, which was the world's first commercial symmetric parallel processor product. So it really is a great honor to be here today.

I just wanted to say at the outset I think that this bill is an excellent piece of work and I think that you both and the other authors, Members of the Committee, are very much to be commended for a visionary and very effective piece of legislation here.

The subject matter of the bill is vital to the Nation's economic development and competitiveness as we enter the new millennium. As the basis of competitiveness among nations shifts from automated manufacturing to information, the state of the Nation's information infrastructure really does become key to the competitiveness.

I would like to focus my brief remarks this morning, in fact, on two particular areas where I think that there might be some improvements made to the bill, based on our experience in the field to this point. The first is in the area of the difficulty of programming of a number of the computers which are currently being used in the HPCC program. It's well known in the computer industry that the development of software is generally far more costly and time-consuming than the hardware. It's, therefore, essential that the hardware be designed to optimize the efficiency of the programmer. Far too many of today's parallel processors have the programmers being used to optimize the use of the hardware.

It has been demonstrated that applications can be developed on parallel processors in a tenth or less of the time required for some of the currently used machines, and I would like to urge that the funds under this program really be focused on machines which can be demonstrated to require no more effort to get applications running on them than the best that have been demonstrated to this point. In this regard, I think that Cray's efforts, for example, are exemplary.

If this is not done, I'm concerned that the funds under this bill and other federal funds which are being focused on the development of applications for these machines really will not be effectively or efficiently utilized and we will not get the results from them that we're looking for and that are so vital to our Nation.

The second issue I'd like to address is one which has been discussed some this morning already, which is the issue of low-cost or free access to a broad band internet for the research and educational communities. Going back to the early days of ARPANET, the government provided access to advanced communication systems, really has stimulated development of whole new applications such as E–Mail and many, many others, which in fact have formed the basis of a whole new industry in this area, which again has been vital to the development of our Nation's economy over the intervening years.

To stimulate the growth of new broad band applications, the government, I believe, really must provide a similar inexpensive access to broad band communications for the research and education environments. At the same time, with the widespread deployment of fiber circuits offering video speed conductivity at the cost of today's voice speed, it's entirely feasible today. But, unfortunately, the bill's requirement that the government lease carrier services, if available, and not offer services if commercial services are available, don't include considerations of the cost of those services.

The carrier-based services are today based on tariffs which really derive from the copper-based cost performance structure of the past, and the carriers have so far been slow in reducing the tariff base to the intrinsic cost performance that's offered by the fiber services out of the perfectly justifiable fear, I think, of eroding the tariff revenue for the voice services which is their fundamental tariff base.

At the current tariffs, copper-based tariffs, the cost of broad band services, I worry, is going to be unaffordable, particularly in the research and education communities. And I worry about that if the funds under these programs, in fact, have to pay for tariffs which are not based on the intrinsic cost performance advantage of fiber, that, again, the funds will not go as far as we hope they will and the results will not be as effective as we hope.

I think the existence of commercial services should not be the only condition for requiring that the government procure them or prohibiting the government from offering similar service, but rather the economic equivalence of the price of those commercial services to the cost of the government services should be prerequisite to such a requirement or prohibition.

I think that the bill's focus on minimizing federal investment in hardware isn't necessarily proper. I think that the proper goal should be to minimize the federal cost overall. If a modest investment in hardware has the potential of reducing the overall cost of providing the services or of the program, then I think that investment in hardware should be made.

I guess in this regard I think that, in response to your question to Dr. Gibbons earlier, I think the timeliness of instituting this kind of an infrastructure is absolutely critical. I think that Japan, in particular, is moving forward very aggressively to wire essentially fiber-based, ATM-based services throughout Japan. The Tokyo Electric Power Company, for example, has been very aggressive in stringing fiber through their rights of way. Obviously, they have rights of way into essentially all the office buildings in the greater Tokyo area.

I think that other nations will be pursuing, offering very inexpensive fiber speed, ATM-type services very aggressively, and I worry that if this Nation does not proceed on a very timely basis that we will be left behind on a competitive basis.

Just in conclusion, I'd like to reiterate my support for the bill and thank you and the other Members both for your work on what I really do believe is a vital issue and for the chance of allowing me to participate. And I hope I can be of some help to you in the future as your work proceeds.

[The prepared statement of Dr. Barker follows:]

Testimony of

Dr. W. B. Barker

President, BBN Communications

A Division of

Bolt Beranek and Newman Inc.

Before the

Subcommittee on Science

of the

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE,
AND TECHNOLOGY

April 27, 1993

Mr. Chairman and members of this distinguished Subcommittee, my name is Ben Barker. I am the President of BBN Communications, and a Senior Vice President of its parent, Bolt Beranek and Newman Inc., headquartered in Cambridge, Massachusetts. I have worked in the fields of high performance digital communications and parallel processing since their inception. As a member of the ARPANet design team, I was responsible for installing the world's first packet switch. My doctoral work was on the architecture of Pluribus, the world's first symmetric parallel processor. It is a great honor to be invited here today to share with you my views on the High Performance Computing and High Speed Networking Act of 1993.

The subject matter of this bill is central to the economic development and competitiveness of our Nation as we enter the new millennium. The bill is well-structured to also ensure corresponding improvements in the education, health and well-being of the Nation's citizenry. The authors of the bill are to be commended. I strongly support the bill.

The pace of change in these areas, dizzying as it seems today, is only accelerating. These technologies will have a remarkably profound impact on every aspect of our lives. Increasingly, manufacturing has become automated and commoditized. There are now automated U.S. manufacturing contractors building products in lot size as low as one, of a quality, at a cost, and with a turn-around time that were un-dreamed of a decade ago. As a result, competition among companies and among nations is becoming primarily based on information, rather than manufacturing. The winners of this competition will be those that can gather, process, synthesize, and communicate information the fastest.

Due in fair measure to the visionary efforts of this committee, the United States is currently maintaining its lead in these areas. However, that lead is being increasingly challenged by both European and Pacific Rim competitors which have been committing enormous sums of money to surpassing the United States. It is a most propitious time to consider what we have learned from the High Performance Computing Act of 1991 to date, and how it might be adjusted to defend and extend our lead.

There are three areas in which I would like to suggest improvements to the bill: in improved ease of use of high performance computing equipment, in improved economic access to the National Research and Education Network, and in networked educational services.

Improved Ease of Use of High Performance Computing Equipment

If there is one area in which progress under this Act has been most disappointing to me it would be the area of usability. We have spent large sums of money developing and procuring interesting and powerful new computers. To date, the results have been primarily in the invention of ways to solve old problems so that they can run on some particular parallel processor which cannot effectively run the traditional solutions, rather than in new discoveries or developments in the fields to which these machines are being applied. This is because the new machines have largely not been designed to take advantage of the lessons learned in the past twenty five years in the development of high performance uniprocessor machines. Key among these lessons are:

- The software is much more difficult to develop than the hardware.
- The time spent developing software to solve a problem is normally much greater than the time taken to run the software.
- In most computer facilities, the cost of the programmers and operators far exceeds the cost of the computers.
- The rate at which a computer can process data is affected first by the efficiency of the software, second by the rate at which data can be transferred from memory elements to processor elements, and only third by the power of the processor itself.

- Consequently, achievement of a practical high-performance computer system requires that the computer and its system software be designed to maximize the efficiency of its programmers, rather than requiring programmers to re-invent means of solving problems to maximize efficiency of the computer.

Achievement of interesting results on most high-performance parallel processor systems currently being built requires ten to a hundred or more times the programming effort required to solve the same problem on a conventional computer. It need not be thus. It has been demonstrated at a number of Government agencies and National Laboratories that it is possible to implement applications on a properly designed massively parallel system with as little as one tenth or less of the effort required for most current parallel processor systems, while simultaneously achieving substantially more efficient use of processing elements.

I believe that an objective evaluation must be done of the level of effort and the level of skill required to implement an application on a given machine or proposed machine. Government funds should not be used for acquisition or development of machines that are more demanding of their programmers than the best that has been demonstrated. It is essential that we not spend our national treasure on a handful of scientists presenting papers on solutions to old problems that can run on some particularly esoteric parallel processor, while our Nation's competitors quietly use more practical machines to solve real problems in the design of circuits, automobiles, aircraft, materials, and medicines.

The current draft of the bill addresses this area by authorizing funding for development of applications. In order to achieve the greatest result from the available level of investment, these applications must be developed for machines that minimize the required development effort.

Improved Economic Access to National Research and Education Network

Section 5, dealing with the National Research and Engineering Network specifies that the Test Bed Network "be developed by purchasing standard commercial transmission services from vendors whenever feasible, and by contracting for customized services when not feasible, in order to minimize Federal investment in network hardware." The section further specifies that "The test bed networks shall not be used to provide services that could otherwise be provided satisfactorily using privately operated commercial networks." I am concerned that it is not clear that the terms "feasible" and "satisfactorily" include economic considerations.

Technology is advancing far more rapidly than tariffs. Fiber optic links can carry hundreds to thousands of times more data than the copper circuits they replace, at essentially the same cost. It is this advance that enables the stunning array of new applications envisioned in this bill. At present, however, the vendors of standard commercial services are continuing to base their tariffs on the cost/performance of copper circuits. If they were to dramatically lower their tariffs, it would immediately erode their revenue base for voice services, while new broadband applications would evolve more slowly, only gradually replacing the lost revenue.

This bill addresses this problem both by developing early broadband applications and by providing a broad spectrum of the citizenry with early and inexpensive access to broadband services. This should build up demand, and thus allow more rapid declines in tariffs. This technology has the potential to make full-motion high-resolution video conferencing as inexpensive as today's phone call. However, until the long-distance desktop video conference is utilized as routinely as today's long-distance phone call, the tariffs will not come down enough to make it economically feasible for the general populace.

If the existence of a service offering by a commercial carrier at a price well above the cost of the Government's service is sufficient to prohibit the Government from providing that service, then I fear that the Government's service will be cut off, the commercial offerings will be economically infeasible for the users, and much of the work under this bill will have been wasted.

Similarly, if the Government is required to obtain services from commercial carriers, even though the tariffs for those services might be many times higher than the cost to the carriers of providing those services, and many times higher than the cost at which the Government could obtain those services, then substantially greater funding would be required to provide broad access to broadband Internet services.

The language justifies the insistence on purchasing services from commercial carriers as being "...in order to minimize Federal investment in network hardware." The objective should be to minimize the Government's overall cost of providing a given set of services. If a modest investment in network hardware can produce a greater savings in service cost, the Government should not hesitate to make such an investment.

I would suggest that economic equivalence, rather than existence, of commercial services be the condition under which the Government must obtain those services or must not offer competitive services. I would further suggest that the objective be changed from minimizing "...Federal investment in network hardware" to minimizing overall Federal investment.

Networked Educational Services

Broadband communications holds the promise of addressing some of the fundamental problems in our system of education, in a cost-effective manner. The bill is well crafted to start to realize on this promise.

The United States is home to the world's most outstanding academic institutions. Unfortunately, not all of the Nation's institutions achieve this level of excellence. Broadband communications will support cross-institution collaborative efforts in the development and delivery of course material. It will allow students and teachers at second-tier institutions to participate in the classes of their world-class colleagues. It will allow centers of excellence in particular specialization, interactively involving students from around the country to economically support a level of expertise that a particular small institution could not justify on its own. It can reduce the cost of college and graduate education by reducing the need to reside far from home to gain access to superlative teachers. It should help bring all of our academic institutions up near the level of our best.

Academic institutions will likely be hesitant to offer their lectures and course materials in this form, as it represents broad distribution of the proprietary material on the basis of which they attract their students and derive their income. At the same time, there is no more effective means of accomplishing the objectives of this bill than the provision of this material. Fortunately, the most outstanding institutions, with the greatest number of applicants for each available position, are likely to be least economically impacted by providing this material. If the Government is prepared to fund universities for course material to be distributed over the broadband Internet, at least on a prototype or demonstration basis, these concerns should be addressed.

I would suggest that the bill include language explicitly authorizing payment to top-tier academic institutions for course material to be distributed over the broadband Internet.

Conclusion

I strongly endorse the High Performance Computing and High Speed Networking Act of 1993. The goals of the bill are ambitious, and the levels of funding modest in relation to the goals. With judicious use of these funds, I believe substantial progress can be made toward the stated goals. I believe that this progress will enable the Nation to defend and extend its leadership in these areas so vital to our Nation's economic and social well-being in the twenty-first century.

Mr. BOUCHER. Thank you very much, Dr. Barker, for that comprehensive statement. You're being a great deal of help to us this morning.

Dr. Rashid?

Dr. RASHID. Mr. Chairman, Members of the Subcommittee, my name is Richard Rashid. I'm Director of Research for the Microsoft Corporation. In that capacity, it's my job to foster the creation of new technologies that allow computers to be used to help people be more productive and to enhance their lives.

I appreciate this opportunity today to speak before you in support of H.R. 1757 and its vision of a digital information future. I think one of the key messages I want to bring to you is that there may be even more opportunities in this future than many people think.

Mr. Chairman, the digital information revolution is already underway. Every 18 months the power of our microprocessors is doubling. This exponential increase in computing power is allowing us to take all of the other forms of communication, all the analog information forms, text, voice, audio, and video, and translate them into the digital language of computers, where we can create with them new and exciting applications.

The future is really upon us. It's already the case that our children, especially the young ones, have a great deal of difficulty imagining what life would be like without computers. A few years ago when my oldest son was six, he was going to bed one evening and he asked me a question. He said, "Daddy, when you were a kid, did you have eight bit computers?" Well, this is the most primitive form of computing he could imagine. I had to admit to him that when I was a child we really didn't have individual computers at all, and that, by the way, we didn't have colored television, either. Well, you can imagine what his reaction to that was. [Laughter.]

Twenty-five years from now our children's children are going to be looking in horror at their parents as they describe analog television, voice-only telephones, and connection to data services through kilobit modems.

In creating the information infrastructure for this digital revolution, I think we will see two key benefits. First, as is recognized in this legislation, new applications, new innovative applications of digital information will enhance our education, will enhance our health services, will make government information more readily available, and will make the wealth of information in our great libraries available to a larger number of people.

I think one point that isn't always well appreciated is that this information infrastructure will also create vast new markets for new products and new services that depend on advanced computing and sophisticated software. Now these are areas where American industries have a tremendous advantage right now in the marketplace. The creation of these new markets where we have an advantage will allow our manufacturers to potentially take back the areas of consumer electronics and the manufacturing of sophisticated machines and help create higher-paying, more skilled jobs for our people and improve our economy.

Now there are three key points that I think—or three key characteristics that I think have to be present in a digital information infrastructure. First, it must be open. It must be possible for anyone with a product or a service to plug into it. I think this is critical for us to provide the kinds of enhanced services that will be important for the future. Entrepreneurs have to be able to compete.

Second, there must be inoperability and interconnectivity. It has to be possible for machines of different types, of different sizes, different software, from different manufacturers, to be able to plug into the network to use its information and to communicate across the Nation.

Third, and I think this is an important point—it has to be smart. We have to build this information structure around smart information machines or what I would call consumer computers, that will really go beyond what we see today in the dumb consumer electronics, to provide sophisticated services to our people, our consumers, and our businesses.

I think this is important because there is an opportunity in the creation of this consumer computing business for our lead in computer systems design and in computer software to allow us to take back the consumer electronics market, as the Nation develops the skills—or the Nation that develops the skills and the expertise in building these intelligent machines will also take the lead in building a wide variety of sophisticated hardware and software for the future.

In conclusion, I have three points to make. First, it's important to think of the information infrastructure not just as wires and fibers and switches, but its real value comes from the intelligent machines, the applications, and the software that drive that system. I think this legislation will promote the creation of new technologies, will create the smart machines, applications, and the software programs that make it possible. I think the challenge for government is to promote the deployment and the development of this information infrastructure in a way that is open, that's compatible, and that's smart without getting involved in specifying the low-level details of bits and bytes and standards that could potentially freeze the technology at yesterday's levels, when the world is changing so rapidly.

Thank you.

[The prepared statement of Dr. Rashid follows:]

WRITTEN STATEMENT OF

RICHARD RASHID

DIRECTOR OF RESEARCH

MICROSOFT CORPORATION

ON THE

IMPORTANCE OF THE DIGITAL INFORMATION FUTURE
AND A NATIONAL INFORMATION INFRASTRUCTURE
TO AMERICA'S INDUSTRY

AT A HEARING ON THE
HIGH PERFORMANCE COMPUTING AND HIGH SPEED
NETWORKING APPLICATIONS ACT OF 1993 (H.R.1757)

BEFORE THE

SUBCOMMITTEE ON SCIENCE
OF THE
COMMITTEE ON SCIENCE

UNITED STATES HOUSE OF REPRESENTATIVES

April 27, 1993

Washington D.C.

WRITTEN STATEMENT OF

RICHARD RASHID
DIRECTOR OF RESEARCH
MICROSOFT CORPORATION

ON THE
IMPORTANCE OF DIGITAL INFORMATION FUTURE
AND A NATIONAL INFORMATION INFRASTRUCTURE
TO AMERICA'S INDUSTRY

Mr. Chairman, Members of the Subcommittee, my name is Richard Rashid. I am Director of Research for the Microsoft Corporation.

Microsoft develops, markets and supports a wide range of systems and applications software for personal computers or "PC's." By making it easier to use personal computers for an increasing number of purposes, Microsoft products have contributed to the "PC revolution" during the last 15 years. The growth of our company has paralleled the increase in the number of people who use personal computers in this country, from one million in 1980 to more than 90 million today.

We greatly appreciate the opportunity to testify in support of H.R. 1757, and to point out more generally the important opportunities presented to America by the digital information future. H.R. 1757, The High Performance Computing and High Speed Networking Applications Act of 1993, will accelerate the arrival of the digital information future by expanding federal support for research and development on applications of high-performance computing and high-speed networks for education, health care, access to government information, and digital libraries.

Summary

The digital information revolution is underway. New technologies make it easier to transform analog messages, including the spoken word, text or pictures, into the digital language of computers which then can be transmitted, processed and stored electronically. In digital electronic form, textual, audio and video information can be combined, used by a variety of different machines in new and exciting applications, and transmitted between different machines.

The United States needs an advanced information infrastructure that will accommodate and facilitate the widespread use of digital information. It would be difficult to overstate the importance of this undertaking. In 25 years we will look back and ask how we ever got along when information was in analog form. In 25 years, the American economy will be as dependent on the information infrastructure we develop today for its economic well-being as it is on the electrical and transportation infrastructures we put in place during the last two generations.

The digital information infrastructure thus conceived offers two tremendous benefits for America.

First, as you, Mr. Chairman, have recognized with H.R. 1757, new and innovative applications of digital information will offer American businesses and consumers -- wherever located -- benefits in such areas as education and health care, and improved access to government information and libraries.

And at least as importantly but to date unappreciated, the information infrastructure will create markets for a wide variety of new products and services which will rely upon advanced computing and sophisticated software. Thus, American manufacturers -- who have the edge in these technologies -- will have the opportunity to take back manufacturing of consumer electronics and other sophisticated machinery from the Japanese, reclaiming highly skilled, highly paid jobs in the process.

But to realize these benefits, our digital information infrastructure must have three essential characteristics.

First, it must be open. This means that everyone must have access to the infrastructure in order to plug any kind of product or service into it. This way, as entrepreneurs develop new and better products, the infrastructure will be able to accommodate the new products.

Second, you must be able to use the same information in a variety of machines and to transmit the information between different types and sizes of machines everywhere. In short, there must be interconnectivity and interoperability.

Third, we must have interactive, "smart," information machines that can receive, process and transmit information. In short, you need consumer computers, not the limited purpose, passive, "dumb," consumer electronics prevalent today. This is the characteristic that gives American industry the opportunity to leverage its lead in computer systems design and computer software to take back the consumer electronics market from the Japanese and others. Moreover, the nation that develops the skills and expertise in manufacturing these consumer computers also will be the leader in manufacturing a whole range of sophisticated machines -- all of which will tie into the information infrastructure at some level.

America's information infrastructure must include high capacity interoperable networks capable of moving tremendous amounts of information practically instantaneously. Thus we commend the vision of Vice President Gore and this Subcommittee in enacting the High Performance Computing Program in 1991. But it is essential to understand that information infrastructure is more than just wires and switches. What makes the network valuable are the information machines that will process the information in useful applications and the software that will make the entire system work.

In all of this, the challenge for government officials is to promote the development and deployment of a digital information infrastructure that is open, compatible, and "smart," without specifying detailed standards for bits and bytes that could freeze technology at yesterday's levels.

Background: The Microsoft Corporation

Microsoft is driven by the vision of "information at your fingertips." The idea is that all the data needed in business, school or at home should be instantly accessible from a personal computer. That means making software programs that are simple enough to use, yet powerful enough to deliver the desired information.

Microsoft's products include system software, such as MS-DOS and Microsoft Windows, that act as a computer's "nerve center" allocating computer memory, scheduling the execution of basic functions, and controlling the flow of information among the various components of the microcomputer. We also develop and market application software such as Microsoft Word and Microsoft Excel, our word processing and spreadsheet programs.

Microsoft is a leader in the global personal computer software market. Last year, more than 55% of Microsoft's almost $3 billion in revenue came from foreign sales. Indeed, the international division is one of the fastest growing parts of the company. Microsoft markets more than 100 products in over 25 languages and has subsidiaries in 39 countries around the world. Our R & D expenditures are significantly more than the average for all American businesses. We employ about 10,000 people in the United States (including over 3,000 programmers and other technical employees) and another 3,000 overseas.

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The National Information Infrastructure of the Future is More Than Just Wires and Switches

To date, when people have talked about a national information infrastructure, most of the discussion has focused on the transmission medium. Most often mentioned is a fiber optic, high speed, "data highway" that will be able to send much greater amounts of information, much faster, than copper telephone wires or coaxial cable (used for cable TV). More recently, attention has been paid to over the air transmission possibilities, such as direct broadcast satellites, high definition television, and personal communications services that would enable individuals to be tied into the network wherever they are.

All of this is incredibly important. But it seriously shortchanges the importance of an information infrastructure.

Let me give you two analogies. First, our transportation infrastructure is not just the concrete and steel making up highways, bridges, railroads and airports. It is also the trucks, trains and planes. There also are the parking lots, stations, terminals, filling stations, restaurants and hotels. There are state highway departments that maintain the roads, toll authorities that charge for the use, and police departments that make sure everyone follows the rules of the road. Another example: electricity. At one level are the powerplants, the transmission lines, the transformers, and outlets in the home. But the exciting thing isn't the electricity itself, it is the appliances we plug into it and the things they enable us to do. Then you need to consider all the businesses and homes which use those appliances to do things, the companies that produce the appliances, and the businesses that support them.

When we consider tomorrow's information infrastructure in this light we can begin to realize just how important it is. It would almost be silly -- if it were not so important -- to even ask how much of the U.S. economy depends on electricity or transportation. You could hardly do anything without it. And twenty five years from now, the same will be true when we talk about the national information infrastructure!

Thus, what makes the digital information infrastructure so exciting is not the fiber optic cable in the ground or low-level satellites in the air. It is not even the fact that information is being produced and maintained increasingly in digital form. What makes all this interesting and important are the machines that plug into the network to do useful (and innovative) things. Today, personal computers, automated teller machines, compact disc players, bar code scanners, fax machines and voice mail systems at the office are all digital. Kodak now has a system for the home photographer that digitizes photographs on 35mm film, enabling you to view them on your television. Soon we will witness the introduction of digital cellular phones and television (HDTV).

Finally, it is essential to understand that what makes this whole digital information system work is software. Fiber optic networks and digital information machines without software are just wires and boxes -- they would be incapable of responding to even the simplest command or forwarding the simplest message. The hardware may be the "muscle" but it is software that is the "brains." Software transforms the raw power of high capacity networks and computers into information systems that help people at work and at home.

In a very broad sense, software does this in two ways.

First, as all information becomes digitized, software helps the user navigate oceans of information to locate or create that which is useful or desired. Software programs will locate and identify information from a variety of databases in response to users' requests.

This experience will have to be applied more broadly. If you go into a library, you will find that it has been very carefully designed over the years to put certain material on certain shelves with card catalogues enabling you to locate them based on various search strategies. But there is no equivalent for on-line information services. There is no equivalent for television. But there will be. Consider that rather than consulting a written TV guide, you will simply be able to touch your TV screen and work through a series of interactive commands. In the future, you will even have software that will learn about your preferences and help you select programs. Thus, if you like to watch John Wayne movies and have watched many of them recently, your television system will let you know when a new one is going to be on.

Second, once a decision is made to send or receive information, it is the software that will actually "pull" the information through the computer's switches and wires that are the physical network. Today, we think about voice moving through telephone wires and video through cable TV and the broadcast television system. But in the future, all the information will be digital -- data that has been manipulated by software. Software will be the key to making the information infrastructure as ubiquitous and unnoticeable as our water supply, plumbing, electricity, or the telephone.

More generally, it is safe to say that as computer and communications technologies become more powerful and less expensive, we will expect them to do more for us and software is the key to making it all happen: always easily and often invisibly.

Benefits for American Users of Digital Information

The digital information age will enable everyone to be "plugged in" to everyone else. People anywhere in the country -- and, indeed, around the globe -- can access, store and process the same information. Thus, tomorrow's information infrastructure will allow people to break the tyranny of geography and location. This is enormously exciting because to date advanced technology and information has only been accessible to very small numbers of people in universities and advanced industries. But in the future, it can be harnessed by nearly everyone.

Moreover, when in digital form, textual, audio and video messages can be combined, allowing information to be integrated in a way that makes multimedia applications possible.

The results of all this are new and innovative applications.

Consider: today, if you can physically get to the Library of Congress, you can get an unparalleled amount of information. In large metropolitan areas we also have great libraries. But we don't have great libraries in rural areas. Yet with the coming information infrastructure, we can make access to great libraries just as available in rural areas.

Another example: Rising health care costs are a crucial problem facing this country. Certainly the United States is the world's leader in developing advanced health care technology. But these wonderful machines are also quite expensive. If we can tie these together in a network, we can share them more efficiently. Rather than having what amounts to a supercomputer built into each CAT scanner, you could have much cheaper machines send the information to a remote supercomputer -- or to a remote specialist for that matter -- where it could be analyzed and a diagnosis returned. Another major aspect of health care costs is simply the huge amount of record keeping -- patient histories, test results, payment information. Electronic processing, consolidation, storage, and transmission of all this information promises tremendous savings.

Entertainment is another exciting area. As long as you have a broadcast system where you have a relatively small number of channels -- and even cable television has a limited number of channels -- a programmer is required to meet the needs of a certain size audience in order to justify taking the space. But the new digital networks will allow us to put literally tens of thousands of different movies, televisions, documentaries, and multimedia information that combine text with graphics all on-line and viewable at one's convenience.

-- Of course, it often is asked who will pay for these

> tailored services? The implication is that individuals will not wish to do so. Well I believe that some will. I also think it is mostly beside the point because advertisers will be delighted to reach such targeted audiences and are likely to be willing to pay a premium for doing so. Thus, it may well be that a viewer will have the choice of either paying directly for a service or accepting a stream of advertisements and letting the advertisers pay for the programming.

Obviously, there are many other things that the new information age will enable us to do, many of which we still have yet to think of. These include allowing people to work at home, avoiding travel costs, reducing pollution, energy consumption, and congestion in our inner cities.

It is important to understand, however, that in order to fully realize the potential benefits of the digital information future it is necessary to be able to use the same information in a variety of machines and to transmit that information between machines.

For example, to improve our productivity and effectiveness at work we need to be able to integrate information received by electronic mail, voice mail, faxes, video mail (coming soon) and electronic documents. Similarly, there is no reason that everyone can't have what amounts to an automated teller machine in their pocket. With a small, checkbook-sized device, one could balance the bank account, manage finances, and pay bills at any point, any time, anywhere.

But we can not assume that the information appliances of the future will in fact develop this way. Today, most of our information machines such as telephones, televisions, and fax machines are more or less passive, limited purpose, "dumb" machines which don't do much information processing.

You can add to these machines' functions a little bit -- such as when you buy a VCR for your television or buy an answering machine for your phone. This helps store information and add some additional functionality. But to make them truly useful, you have to add a lot of equipment -- and it's difficult and expensive to do.

To fully realize the potential of a digital information future, you need interactive, smart machines that can receive, process and transmit information. You don't need consumer gadgets -- instead you need consumer computers.

The difference between your telephone and an answering machine would be just the piece of software that stores the information for you. On a personal computer, the difference between a word processor, a spread sheet program, a data base or a game is merely different software. Changing the features, or even the utility of the consumer information device, can be done simply by changing software. Not only does it allow us to benefit from the myriad applications that will be developed to use all the information available, but it also gives America the chance to take back manufacturing of consumer appliances.

Benefits for American Manufacturers of Information Machines

The need for smart, interactive, consumer computers to fully realize the possibilities of the future information infrastructure gives America the opportunity to take back the lead in manufacturing those devices.

Time and time again, American creativity, ingenuity and entrepreneurship have developed new consumer electronics: copy machines, fax machines, and the VCR all were invented here. As members of this subcommittee know well, the Japanese (and other countries) have been extraordinarily successful in mass producing these relatively "dumb" consumer electronics. They have made incremental improvements, lowered costs, and miniaturized. Yet fundamentally, manufacturing this equipment is essentially assembling components.

-- Indeed, the same holds true in the semiconductor industry. Americans have largely been responsible for the design and architecture of chips. But the Japanese have been successful at manufacturing based on existing designs and then making incremental improvements. For example, they make a memory chip that has slightly more memory.

But the U.S. continues to lead the world in computer system design and architecture and the software that goes into them. These are American technologies driven by companies in the United States who have shown a continuing ability to keep the pace of innovation up.

In these industries, incremental designs are insufficient. Technology moves too fast. Instead, you must make revolutionary changes and do so on a regular basis. The frequency with which these changes must come about has been such that few outside the United States are able to keep from falling off this fast moving technology treadmill.

-- The personal computer itself is exactly one of these examples. American companies innovated the hardware and software and, despite predictions that foreign manufacturers would overwhelm the U.S. PC industry, it simply has not occurred. In fact, right now U.S.

> manufacturers such as Dell and Compaq have started a price war over computers sold in Japan. They have not only become very effective in selling their machines there but they are changing the nature of that industry.

So we have a major opportunity to leverage our lead in computer hardware and software to take back the consumer electronics industry from the Japanese (and other producers). If that happens, we are also going to take back lots of high paying interesting jobs. Precisely the types of jobs we need for America's future.

This point deserves to be emphasized. Whoever figures out first how to manufacture these smart appliances will be the leader for many years to come in manufacturing a whole range of complicated machines. Industrial air conditioners, trains, machine tools all will be heavily computerized and all will plug in at some level to the digital information network. (The only devices that will not be "smart" will be entry level "commodity" type items.) Thus, the nation that develops the skills and expertise in such manufacturing will command a powerful position as we enter the next century. Remember: someone will learn how to manufacture these devices -- if we don't, our foreign competitors will.

Conclusion: A Vision For America's Information Infrastructure

In order to fully realize the potential of the digital information future -- both for users of the information and manufacturers of the consumer computers hardware and software -- **the United States needs a digital network with three characteristics.**

First, it must be open. Just as our electric system allows us to plug in a wide variety of appliances made by many different manufacturers and the highway system allows everything from motorcycles to 18-wheelers, the digital network must allow us to use all kinds of products and services in order to take advantage of the best technologies and the most innovative applications. The network must be an open platform that allows people to use whatever products best meet their computing and communications needs, whether they are mobile computers, supercomputers, medical diagnostic machines, or smart televisions.

Second, there must be interconnectivity and interoperability. We must ensure that the same information can be sent to and from different types and sizes of machines everywhere. This is essentially the same type of problem that exists today when trying to connect different types of computers running with different software in local and wide area networks;

only in the future the problem will assume much greater dimensions because there will be so many more machines trying to communicate with each other.

But how do you ensure such interconnectivity and interoperability? Frankly, we are hesitant to suggest a top down government imposed standard. We think it is simply antithetical to the fast moving technology treadmill with rapid technological innovations. Instead, we believe the way solutions to the connectivity problem have developed to date is instructive. Essentially the government got things going and American industry took off from there. Let me explain.

Today there are an estimated 5 million people worldwide connected through several thousand interlocking networks in a large electronic web called the Internet. Indeed, some analysts believe the Internet traffic rate is growing at rates as high as 15% per month. As you know, our federal government created the backbone of this network by financing the construction of links between universities, research laboratories, and military installations. But increasingly businesses and individuals are using the system to communicate and provide information services. Importantly, it is the private sector that has been able to keep up with technological developments and establish protocols and procedures for linking disparate networks into a larger whole.

We think something similar should occur with respect to the development of the next generation of data networks. For that reason, we are pleased that H.R. 1757 authorizes federal funding to develop new technologies. The High Performance Computing and Communications Program, which this Subcommittee played a lead role in enacting, is an important first step toward the digital information future. H.R. 1757 expands the HPCC Program to include development of technologies to support important applications that will benefit many Americans. The demonstration projects authorized by H.R. 1757 in education, health care, access to government information, and digital libraries will provide a forum for the government and the private sector to work together to develop new applications -- which really are a combination of computer hardware and software. Given the great uncertainty regarding the way in which many of these technologies will develop we think it is wise to seed many test beds; certainly we at Microsoft are betting on many different horses.

We also think there is an appropriate regulatory role for government in encouraging the deployment of technology. Yet from a technologist's perspective, I simply caution that it will require extraordinary vision and leadership by government to promote technology but at the same time not accidentally get in the way by freezing technology at yesterday's levels.

-- The dilemma is illustrated by the question of deploying

> ISDN -- the Integrated Services Digital Network. ISDN enables the telephone network, which was built for traditional analog voice calls, to carry far more information at higher speeds. As a result, ISDN enables the development of many new applications in education, health care, videoconferencing, telecommuting, etc. Moreover, it can be done soon and at relatively low cost. Thus, we believe it should be encouraged and is a significant step towards the digital information future. Yet at the same time, it is only an interim development: the capabilities of ISDN pale besides a truly high speed fiber optic network. So we would be extremely hesitant to support any government action that precluded the development of fiber while promoting ISDN.

Third, we must have interactive, "smart," information machines that have computing "built into their woodwork." These will come in a variety of shapes and sizes and perform very different functions. Some will be larger than today's desktop computer. They will have displays geared towards viewing in a living room or for multiple viewing in a conference setting. Others will be smaller than today's desktop computer. They will range from relatively simple computers embedded in small appliances, to battery powered machines that will live in a pocket, to electronic notebooks.

I think it is useful to keep in mind two basic models.

The living room machine will get a lot of attention because, assuming a fiber optic network, large (high definition) screen, and the ability to do graphics and video processing, such a machine would replace the television and all that entails. I call this the "Video PC."

The pocket computer -- and it will be a real computer, not just a limited purpose scheduler -- will be an individual's mobile connection to the information network. The general purpose nature of this machine will allow people to combine applications such as messaging, keeping organized, taking notes, finding out where you are and how to get to where you want to go, financial transactions, etc. It could replace hard copy documents of identification and authentication, memberships, cash, checks, credit cards, receipts, keys, tickets and schedules. For these reasons, I call this type of machine a "Wallet PC."

If America succeeds in promoting a digital information infrastructure with these fundamental features, I have little doubt that:

- As users of information, American industry will innovate in the development and deployment of productive applications. Quite simply, it will not be possible to have an effective, efficient business ten years from now without being involved in all this.

* As manufacturers of information machines, Americans will reclaim highly skilled, highly paid jobs by leveraging their lead in computer system design and software. Those who learn this new industry early, invest in it, and champion its cause, will be the big winners. And if it is not us, be assured that it will be others.

Thank you.

Mr. BOUCHER. Thank you very much, Dr. Rashid, for that very cogent and helpful statement.

And the Subcommittee's thanks to all of the witnesses for their testimony this morning.

Let's see if we can get fundamental agreement on what the government's role ought to be in terms of developing this information superhighway. What I'd like to do is set it before you as a proposition and try to define what the elements of a proper government role in contrast to the private sector role would be and just get your comments as to whether we have properly identified the government-related elements.

First of all, I would hope we all could agree that the government should fund research and development for new networking technology, for a new generation of switches, for software that will help us address and route all of this information traveling at gigabit speeds across the network, and for the kinds of applications that we've set forth in this bill that would help us use the network for medical imaging, for digitizing libraries, and connecting institutions, and having the information essentially be available to anyone throughout the country.

Secondly, I would hope we could agree that the government ought to create a test bed that would allow for the demonstration of the technologies that have been created through the research and development effort and that also could provide direct connections for high end uses where the private sector has not developed the level of technology and the capability of the network to the point that it can itself provide those connections. So if you need to have supercomputer sites, for example, or research laboratories that need to be connected to those supercomputers interlinked, and they have to have a speed of transmission that the private sector doesn't provide, that it would be a proper role of the Federal Government to provide that direct connection.

Third, it would seem that the government ought to set common standards and protocols or at least stimulate the setting of those standards by some other means, so that the network does operate in a seamless way, and that data that is available at any place on the network can be accessed at any other place on the network, and that would seem to be a proper government function.

To the extent that it is difficult because of limitations of financial resources for schools and libraries and state and local governments to be connected to the internet, it would seem to be a proper government role to provide directly those connections. I would appreciate your comment on the appropriateness of that.

Then I noted with interest Dr. Rashid's suggestion that we need to make sure that the network is, in fact, fully interoperable, and I would point out that the network today is essentially owned by some 1,300 local exchange carriers. These are the local telephone companies that provide local loop service all throughout the Nation. There ought to be some means to make sure there is a way that these companies can work together, so that future advances in the local exchange can be planned and managed and coordinated in a compatible way. I have introduced another bill that would accomplish that result, and your general comments on whether that is a proper approach I think would be extremely helpful.

Then I'd like to get your advice on how we accomplish that part of broad band network deployment that is the most difficult and the most costly. The government, in my view, should not do this. The private sector should, but how do we get to that point. And that is deployment over the last mile from the telephone company switch into the premises of the end user in the homes and businesses across the country.

One of the witnesses commented on the fact that Japan has a very aggressive program already in the works to accomplish that deployment across the last mile. In fact, it has targeted the date 2015 as the year by which every home and business in Japan will be connected to its network with a broad band capability. How do we go about accomplishment that goal in the United States? Once suggested way is to allow telephone companies to offer cable television service within their telephone service areas as a means of giving them the financial incentive necessary to accelerate deployment of fiber optic technology, other kinds of broad band technology, and digital switches all throughout the network. Is that a proper goal? What about allowing cable companies to offer telephone service as a way to stimulate their deployment of broad band technology, again with the goal of getting the end user tied into this network with interactive capabilities? And any other suggestions that you have for how we might accomplish that deployment over the last mile would be very welcome.

Well, there are several questions there, and I would call on you each in turn to offer your comments on whether we have adequately defined the government role in this and what other steps the government ought to take in order to achieve the objectives that have been specified.

Mr. Tauke?

Mr. TAUKE. Thank you, Mr. Chairman. This gets right to the heart of it. I think one of the issues that confronts you as you address this area of policymaking. Commenting on the outline that you offered, first, I think generally you have hit the nail on the head in defining the government role. There are two areas where I would like to clarify at least our thinking.

First, in the setting of standards and protocols, I think it's best to emphasize government, as you alluded to, as potentially a promoter of a standard-setting process, but we believe that generally having the private sector actually set the standards has worked reasonably well with the government in a sense promoting, prodding, overseeing that process, and we would like to see that model continue wherever feasible.

The second comment on your five areas of government operation or role would be in the area of providing interconnection. We believe that if we're trying to hook a local school into internet—let's say, the local elementary or high school—that the government rule should be to provide—the preferred route would be for government to provide direct funding to that local school that that local school can then use to buy services on existing networks. Rather than having that local school district go out and build the network or purchase private line services from existing telephone network or whatever, or I should say purchasing the building of a separate private line from the telephone industry or some other segment of the communications industry, we believe it would be preferable for the funds to go to the end users to purchase services rather than build facilities. And we believe that that is one of the ways in which you can stimulate the development of this network and you enhance the probability that the network will become ubiquitous in communities.

I don't want to be parochial, but again going back to my home state which has had some experience in government trying to deploy a network in order to jump-start the National Information Infrastructure, the legislature is now struggling with the fact that once you get it to the school, then how do you get that tied in with the local households that are in the same block or two blocks or three blocks away? And, in essence, you don't want to get into a situation where you have built one entity or structure or architecture or network for a selected group, but you haven't facilitated the expansion of that to other players.

The last comment is that in order for us to integrate these networks, I think we have to understand that there are a number of obstacles that have to be addressed. Pricing issues were alluded to by Dr. Barker. I mean, the fact is that the private sector today doesn't provide a comparable service generally at a comparable price, and that needs to be addressed. Some of the regulatory issues that you alluded to needed to be addressed. There will be a series of public policy questions that have to be addressed in order for us to reach that NII vision, but if you have the right framework, which you're putting in place, then we will begin to gradually move those decisions through the process.

Mr. BOUCHER. Thank you, Mr. Tauke.

Mr. Ewald?

Mr. EWALD. To go through the points that you raised one by one, we would feel that, in fact, government support of the R&D activities, the network technologies, high performance computing, that is absolutely appropriate. Secondly, creating the test bed, the demonstration prototypes and vehicles, those are clearly appropriate and our member company, CSPP's member companies are participating with the national labs and other industrial participants in some of those activities.

Use the word "stimulating." The setting of standards and protocols, we would support that that clearly is a government role. The caution there, of course, is that we don't standardize too soon. And so as we're able to have some experience with the test beds, with the R&D, with the actual practice of implementing these networks, then standards can come along. We have to be careful about getting ahead of the game, however, or we will limit the ability to move ahead.

Connections for universities, libraries, organizations like that which are a key part of the National Information Infrastructure, those organizations are supported in many ways by federal activities, by federal funds, and so as a part of that granting process supporting part of their ongoing business through granting them the ability to get on the NII, we believe would be appropriate as well.

You had a question about creating networks of networks really, if I put it in those terms, and clearly that will be a way that this gets implemented. There are many networks in existence today.

They will have to interoperate and all the rest. Exactly how that happens, we have not taken a position on. We, again, come from the computer systems perspective, and the cable companies, telephone companies, and all the rest of that I think will have to be worked out, but we have not taken a position on that.

What is clear, however, is that there has to be a mechanism in place to be able to actually deploy the NII out to workstations or personal computers in people's homes, in offices, in research laboratories all across the country. So deployment clearly is an issue, but we don't have a position on exactly how that last mile should be done.

I would add a few thing, and they will sound very familiar. And they are other things that we believe that government should take the lead on—is the partnering with industry, the applications development work that will take place, and then the focus on results here, delivering real results. And, again, our desire is that this is not just—and I know it's yours as well—not just an R&D program, but there is a component of R&D, but it's really focused on deployment and on results and on producing something. And to do that, we have to use computers and networks and software and workstations that work today, that are demonstrable today.

Mr. BOUCHER. Mr. Ewald, I realize you're speaking for a larger group of computer industry chief executive officers today. To this point, you have confined your comments just to those areas where the group has taken a position, but you personally have a great deal of expertise in this area, managing as you do the supercomputer program for Cray Research. And so let me just ask for your personal view, departing from your role as spokesman for the larger group.

We are very interested in trying to come to practical terms with a means to make sure that the network of networks is, in fact, fully interoperable, that these 1,300 locally-owned networks throughout the country are managed in such a way that they're compatible, so that the information kind of flows seamlessly from one point of the Nation to any other part of the country.

One way to do that is to have the Federal Communications Commission instruct the local telephone industry to plan and manage changes in the network in such a way that we meet that goal of interoperability. Is that logical approach? I mean, do you think that makes sense? And do you have any other ideas for how we might meet that goal apart from that approach?

Mr. EWALD. Speaking now for Cray Research and not CSPP, a couple of things are clear to us, and that is that we do need very broad connectivity. So, again, the idea of having networks of networks and the interoperability, that is key to implementing this. It's key to the ongoing competitiveness of the country, of getting information around the country. So, as a company, in fact, we support that and we probably desire higher speed connections to homes and other places than others would because of the type of computing that we see being able to be done. This example that I talked about coming from Germany before is just one example.

Translating that, though, in terms of do we know enough yet today about should we be dictating that we need a fiber connection to every home or should we use coaxial cable through the cable TV companies—I don't think we know enough about that yet, nor do we know enough about the emerging protocols that are being used—again, Cray Research doesn't. Between work that's being pushed on Sonnet, on ISDN, on ATMs, and all of that, it is not yet clear to us yet what the actual physical implementation models will be. Our guess is, frankly, that there will be multiple physical implementations of getting communication out to individual homes and laboratories, and belief is that it's probably a little too early to say that there will be just one.

Mr. BOUCHER. Okay. Dr. Barker?

Dr. BARKER. Well, I apologize for being repetitive, but I mostly agree with all that's been said here. I think that your definition of the proper role of the government I think is entirely appropriate, funding R&D, funding the applications such as defined in the bill, and creating of test bed networks to allow demonstration and experimentation in those areas.

In the area of common standards and protocols, I'll say that it's unprecedented, I believe, historically in the communications industry the amount of consensus which is currently being formed on a new set of broad band ISDN, ATM standards. There has never been such an agreement between the traditionally disparate voice and data communities, between the traditional local and wide area, between the traditional applications and emerging applications areas.

So I think that—and those standards, furthermore, are clearly being defined in the context of and internetworking environment, a network of networks, a network of networks of networks. And so I think that that is progressing, in fact, astoundingly well, unprecedented historically. And I think that the government's role, I don't believe, should be dictating. I believe that involvement and advising and making sure that the services and products, the extent of products that are being acquired, in fact, conform to those emerging standards, I believe is appropriate, but I don't believe the government should be defining those emerging standards.

I guess in terms—I do believe that the government does need to be providing, as you say, connectivity to organizations such as schools, educational and research organizations. I would view that as a set of services the government needs to provide to those institutions for the reasons you've outlined which the government should, in fact, procure on what is the most economically basis for the government to procure those, rather than it being decreed that they should be procured along a particular set of lines independent of the relative cost of that and other kinds of possibilities.

In terms of your questions about allowing telephone companies to offer cable or cable companies to offer telephone-type services, I do believe that as the newly emerging set of standards become broadly accepted—and we've seen it accepted at this point within the cable industry as a means of providing on-demand cable, with Time–Warner, for example, with any number of the telephone companies, and so forth—I think that, in fact, the services which are going to be used by those various organizations to provide connectivity to the office building or the home are, in fact, going to be technologically indistinguishable, and, therefore, I think the legislative or judicial restrictions on allowing them to provide the full range of services really become obsolete and no longer sensible.

Mr. BOUCHER. They become barriers, in fact, don't they, to a more rapid pace of deployment of the broad band technology?

Dr. BARKER. I believe that very strongly.

Mr. BOUCHER. Okay. Dr. Rashid?

Dr. RASHID. Well, in my earlier statements I already pointed out that our strong agreement with the direction that this legislation is taking in terms of support for research, in terms of support for libraries, educational institutions, I think that's a very important part of it. I think that will stimulate a great deal of intellectual activity and innovation.

In the area of standards, I agree with the other panel members; I think the government's role is to set goals, to act as a catalyst, to inspire. Ultimately, I prefer leaving lowest level decisions to the scientists and the engineers who really understand the problems at a particular point in time. And, of course, it's important to recognize that there are no ultimate answers and ultimate solutions in our business. As I pointed out, the rate of innovation is so great that almost anything you do today will be obsolete in five to ten years.

In terms of the interconnectivity issue, I think that's absolutely crucial. I think it's important in order to create the kinds of new industries that we're talking about creating, that we be able to provide good interconnectivity, good open connections to all the different potential players, and any regulatory mechanisms that can be used to help achieve that I think are desirable.

With respect to the point about cable television and telephone services, I think the comment that Dr. Barker made is basically correct. Technologically, these industries are rapidly emerging, and sort of the reality is that there are two major kinds of companies that have wires into people's homes. We will certainly be able to provide common sorts of services across those wires, and I think it will be an important set of public policy decisions to decide how to allow that competition to take shape.

Thank you.

Mr. BOUCHER. Well, thank you very much.

It seems that a common thread through your answers is that the government should not be setting the standards and protocols, but needs to be a catalytic force in order to have the private sector accomplish that result. I'm sure you've looked at the provisions of our bill that encourage research and provide the general guidance for that kind of standard-setting. Are we targeting that about the right way or is there something else we ought to do to make sure that common standards, formats, protocols, are, in fact, established for the storage and retrieval of information?

Who wants to answer? Dr. Rashid, do you want to comment?

Dr. RASHID. Well, I think this is an area where the devil is usually in the details. I think that the general flavor of the legislation is correct, that the general view that government can help and provide inspiration into setting standards is an accurate one, and I think that the biggest concern in the long run is trying to make sure that the process doesn't become so bureaucratic that our competitors outside the United States are able to leapfrog ahead of us.

Mr. BOUCHER. All right. Does anyone have anything else they'd like to offer on that particular question?

[No response.]

Mr. BOUCHER. Let me turn to another question, and that is this: Mr. Tauke suggested that there may be a problematic quality to our provision with regard to connecting schools, libraries, and state and local governments because the legislation does, in fact, suggest that the government could provide funding both to connect these institutions directly to each other and also to connect them to the internet.

Now my question to you is this: if we're going to provide for government funding of the connection of these institutions directly to the internet, is there any reason that we should consider a work-around of that, another connection that would allow these institutions to be linked directly to each other?

The suggestion Mr. Tauke, speaking on behalf of the telephone industry, is making is that perhaps this would provide a government competition for the telephone industry that might be unjustified. Any thoughts on whether we should take that second step once we've already provided for connections to the internet by saying that these facilities, through the use of government funds, could be linked directly to each other?

Mr. Ewald?

Mr. EWALD. It would seem to me that the key thing that the libraries have—I think there are two things here, the libraries and organizations like those who are repositories of data, and the key then is to be able to link the libraries to people who can use the data. And, similarly, the schools or places in state governments, local governments, are places that will consume data. So, in that sense, perhaps it makes some sense to think that they could be connected together.

But I would think at least that the more general use of the data that the libraries have is across the spectrum of the country, not just within that community. So what would make sense to me would be the broader set of connections.

Mr. BOUCHER. Let me just walk with you, if I may, through the technology of this. If we have broad band connections linking these institutions to the internet, and assuming the broad band capability of the internet itself, what would be gained by linking the institutions directly through yet another broad band connection? Why wouldn't the internet connection in and of itself be sufficient?

Mr. Ewald?

Mr. EWALD. I think that's a good question and one that I wouldn't challenge. What you could imagine, if there were higher speed connections, if there were a subnetwork, for example, connecting these together, that they might be able to have higher speed connections; they might be able to share more information through that backbone. But, ultimately, it would seem to me, again, the key is to provide that information to people all over the country, to industry, and so the key there, I think, again, is high speed connection between all the consumers of the data and people who will turn the data into information. I wouldn't disallow that the libraries all be connected together, but they could certainly do that over the internet. I don't know how to say it differently.

Mr. BOUCHER. No, I think you said it well.

Dr. Barker?

Dr. BARKER. Thank you.

I guess I'm not sure that there is that substantive a difference between the two sides, in that the internet is nothing more than a network of autonomously operated networks anyway. Those separate networks have sprung up in fair part to address some particular need of some particular community; for example, the need to provide higher band width services. I mean, I can imagine in the educational community, for example, using OC–III speed ATM to provide real time sharing of course materials, so that you could have centers of expertise at some of the outstanding universities that would be shared by students from around the country. That might require a capability which is well beyond what today's internet's capability is in any short-term time frame. Therefore, it might require construction of what is in some sense a new network to provide that capability, which would then simply become a part of the internet and a resource which then presumably might be more broadly utilized by a broader community on some fee basis.

Mr. BOUCHER. If, on the other hand, what we're attempting to do is get basic connections into elementary and secondary schools, for example, across the country, would it not be a significant step forward and probably the first goal that we ought to achieve to simply get those institutions connected with a broad band capability to the internet itself?

Dr. Barker?

Dr. BARKER. I believe that that is a very important goal. I think that it will be a longer time before those institutions have the capability to really fully utilize the broad band width. I think that some of the higher education institutions will have the resources to, in fact, be able to utilize those services more quickly, but I do believe that as quickly as possible, using broad band connectivity as a means of disseminating that kind of educational expertise broadly, both geographically and vertically through the educational structure, I think is a very important goal of this legislation.

Mr. BOUCHER. And without belaboring the point, let me just ask: If what we're basically trying to do is connect libraries in such a way that people in their homes or business people in their offices can browse through an electronic index and retrieve a specific document and print that out on their laser printer, it would be enough just to have it connected through the internet, would it not? We wouldn't have to have any direct connections among libraries that goes beyond that?

Dr. BARKER. To the extent that there is an internet component with adequate broad band and protocol capability to support that kind of usage, absolutely.

Mr. BOUCHER. Okay. Mr. Tauke?

Mr. TAUKE. Well, Mr. Chairman, just to attempt to clarify a little bit the point that I was making, if I might, I think that there will inevitably be a variety of interconnections among institutions of learning, elementary schools, higher education, secondary schools, others. And that is good. I think what we are talking about here is our concern that when funding goes to an institution, a school district, a state university system, for access to internet, that we would prefer—we think it's appropriate that the preference be that that money go to the end user to purchase services rather than going to build facilities.

And, in essence, the question, I guess, comes down to who controls the excess capacity over a given connection. We believe that, in essence, that excess capacity shouldn't be controlled by the local elementary school, but instead that that excess capacity should be controlled by a provider of services, whether it's a cable company, a telephone company, or whoever it happens to be. Because by allowing that excess capacity to be controlled by a private provider of services, then you can facilitate, we think, the hooking in of residential customers and others into this network.

One of the concerns is that we not, in a sense, have disconnected networks out there that have excess capacity that try to sell that capacity in a way that undermines the ability of our traditional public switch network to have the traffic on it, so that it can be upgraded, so that it can be interconnected into this system. And it's a little difficult sometimes to determine exactly what's the right way for the money to flow, but if we can think about flowing it, having it flow for the purchase of services where the excess capacity of whatever structure is built to deliver those services is controlled by the private sector environment, rather than by the user, we think that is preferable.

Mr. **Boucher**. I don't disagree with that. The problem that we have is that in many environments it's not going to be commercially attractive for the local telephone company or the local cable company to deploy a broad band capability into an elementary school, for example, that leads back to that telephone company switch, or if the cable company chooses to put a switch in, to that company's switch. And where that is the case and we still want to achieve distance learning potential for that particular elementary school, it seems to us appropriate that the Federal Government would then help to finance the installation of that broad band connection. That's what our connections program is all about. You don't disagree with that as a policy goal, do you?

Mr. **Tauke**. As a policy goal, we don't disagree with it. I think that the question arises, first of all, if there is a customer who has dollars to pay for the service, how often will the situation arise that no one will provide the service? We believe that those dollars, if you will, will serve as a catalyst for the construction of the facilities necessary to deliver that service to the school and eventually to others in the community. And, theoretically, that's how the dollars would best be used.

Now if a school has this pot of money to purchase those services and nobody wants to build the facilities, then that's another question. And I think that somewhere along the line the policy has to be made that perhaps government does have a role to play, then, in the building of that link, and then the question of capacity—who controls the capacity—becomes an issue.

I happen to serve on the board of a college where the word went out that the college would sell capacity to businesses in the community, so that they could buy capacity on the college link to get into the network. That, in our judgment, is a problem because we would argue it's an unfair competition, but really that's a somewhat minor problem compared to the bigger problem, is it reduces the incentive or the possibility of those businesses being served by a larger network that gives the whole community access to the broad band capability that we are seeking for the entire Nation.

Mr. BOUCHER. It sounds like you're commenting in part on the means by which we will distribute the government financial support to establish these connections.

Mr. TAUKE. And how that money is used.

Mr. BOUCHER. Yes. Put it in the hands of the end user, and then it might then become commercially attractive and feasible for the telephone company or the cable company to provide the connection. It's a fair point.

I have some other questions, but I'll defer those for now and recognize the gentleman from New York.

Mr. BOEHLERT. As usual, the Chairman has been very comprehensive. I've been sitting here for thirty-eight minutes for his five minutes of questions. [Laughter.]

Mr. Tauke, let me ask you, what impact do you think this bill is going to have on the existing telephone network?

Mr. TAUKE. Generally, we believe this legislation will have a positive impact on the existing telephone network. Understand the network as we know it today is not going to be around for a long period of time. We know that in order for us to be able to be providers of communication services that we're going to have to offer that multimedia capability—data, voice—interactive multimedia capability that the children of tomorrow will be seeking, and so will their parents, I guess.

And so, consequently, we see our network moving toward this vision of a National Information Infrastructure as other networks, including internet, will be moving toward that vision. And insofar as this legislation advances that cause and insofar as it promotes inoperability and tries to get us to the point where we are encouraging the development of user friendly applications that will put more traffic over this network, all of these things we think are positive for our industry. So as a general rule, I think we believe this legislation moves in the right direction.

Mr. BOEHLERT. I'd like to ask you and the other panel members also if you're satisfied with the provisions in the bill for private sector input through OSTP and the other Federal agencies on the implementation.

Mr. TAUKE. Are we satisfied?

Mr. BOEHLERT. Yes, yes.

Mr. TAUKE. As I alluded to both in my oral and written testimony, we think that this issue of private sector input, decisionmaking, management, as Mr. Ewald referred to it, these are very critical issues. I mean, this has moved from the stage where it was kind of an experimental activity and a relatively narrowly-confined activity to one that is becoming big and reaches a lot of people. It has 10 million users. We're going to have a lot more money going into it.

And so as a result, we believe that the decisionmaking processes should become a bit more formalized, the management a bit more structured. We don't want a lot of regulation. Understand that. As a bias, we don't want a lot of regulation of this. But it's important that users and providers of services have a place they can go where (a) they can get decisions made; (b) they can raise points of concern; and (c) if you will, comment and talk things out.

We have fairly good processes in our government generally for doing that, but it is very difficult I think for all the players connected with NREN internet to figure out where you go to make a point if you have a concern. That's been a problem. And if you have read the Inspector General's report, you can see that on things like the acceptable use policy question, which was a major policy decision, there was not a normal formal rulemaking procedure which would allow for public comment and input. We believe that by following some of the recommendations in the IG report and looking a little bit at some of the structures set in place in this bill that we can put in place a process that is going to serve this effort, this program, well and allow everybody to have input in an orderly and timely way.

Mr. BOEHLERT. Mr. Ewald, would you comment on that?

Mr. EWALD. Yes, sir. Really comments fall into two categories. One is that we think that the bill sets up a framework which will allow for good forums for input and improved management. So I believe that the framework is there. The real test is this second issue, and that is how it gets implemented, and we would just come back to wanting to make sure that there is a valid and accepted way for industry to put in comments, to provide some oversight, and then, as importantly, for the Congress, the administration to measure the results. We've talked about results several times.

So I think, in summary, the framework looks like it's there. The real challenge I think will be on implementation to make sure that industry gets listened to and the advisory committee, and then, secondly, that we know what the programmatic directions are and that the results get measured on an ongoing basis, and change the program if we're not meeting the results. We've got to meet these results and get going.

Mr. BOEHLERT. Okay. Dr. Barker?

Dr. BARKER. I think I have very little to add to Mr. Ewald's comments.

Mr. BOEHLERT. Dr. Rashid?

Dr. RASHID. I think basically the same point. I think it's ultimately the case that you don't want the government running the network. I mean, you really want the private sector doing that. But certainly there's going to be a significant transition period, and I think the opportunities for everyone to participate—from industry, from the academic, and from the government—are very important.

Mr. BOEHLERT. Mr. Tauke, the bill includes a restriction on the use of test beds for other than experimental purposes. Does that restriction satisfy the concerns raised by your CEO last month?

Mr. TAUKE. As indicated in our CEO policy statement, we believe that that kind of restriction was appropriate and we believe that the restriction is correct insofar as it applies to the NSFNET backbone and the test beds. We do believe that there is some need for additional clarification on the funds that go to the mid-level networks and what those funds may be used for. And that was the issue that I addressed a few moments ago with Chairman Boucher.

Essentially, we think that the funds should be expended in such a way that the end users purchase services and do not end up controlling substantial amounts of excess capacity, which they then market in the community.

Mr. BOEHLERT. Okay, thank you very much. Thank all of you.

Mr. BOUCHER. Thank you very much, Mr. Boehlert.

One of the witnesses—and I can't recall which one; you can volunteer when I ask the question—recommended that among the goals of our national research and education network initiative should be a guarantee of openness, so that any user of the network has an equal opportunity for access with all other users. And I can't recall, as I indicated, who suggested that, but I'd like to ask you if you think that our legislation has the appropriate guarantees of that degree of openness, and if we don't, do you have recommendations for ways that we could better assure it? In short, is there anything further that we need to do statutorily in order to make sure that everybody in the country has access to this network and a full opportunity to utilize it?

Dr. Rashid?

Dr. RASHID. Yes, I think I was the one that made that comment. And the comment was really directed at the notion that we need to provide a mechanism to make sure that people with products and services that want to access the network and make their services available are allowed to do so.

I can't right off the top of my head point to anything in the legislation that would preclude that, and I think, in fact, that the provisions that are there are a good step in that direction. Ultimately, this is something that's going to require a fair amount of attention, though, from the government as the networks evolve and as the circumstances change.

Mr. BOUCHER. I want to express the appreciation of this subcommittee to each of the witnesses for their very helpful assistance today.

Mr. Tauke, I want to thank you for the very helpful comments that were provided as a result of your appearance here on February 2nd and the recommendations, very extensive in nature, that were forthcoming as a consequence of the dialog that we had at that time, many of which are reflected in the bill.

And to our witnesses from the computer industry, I'd express our appreciation not just for your appearance here today, but for the help of the larger project that is comprised of the chief executive officers of computer companies in the structuring of, first, the High Performance Computing Act of 1991 and then, subsequently, giving us some very useful thinking that has served as the foundation for the bill upon which we're having this hearing today.

We will continue to consult with you as we consider additional refinements before we act on this measure, and you can expect many additional questions from us as we proceed down that path.

With the subcommittee's thanks to these witnesses and to Dr. Gibbons, there being no further business to come before the panel today, this hearing is adjourned.

[Whereupon, at 11:56 a.m., the Subcommittee adjourned, subject to the call of the Chair.]

H.R. 1757—HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993

THURSDAY, MAY 6, 1993

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Science,
Washington, DC.

The subcommittee met, pursuant to recess, at 1:56 p.m., in room 2318, Rayburn House Office Building, Hon. Rick Boucher (chairman of the subcommittee) presiding.

Mr. Boucher. The subcommittee will come to order.

This afternoon the Science Subcommittee continues its hearings on the High Performance Computing and High Speed Networking Applications Act of 1993, H.R. 1757. The bill creates research, development, and demonstration efforts in high speed networking technologies which are essential to achieving the Administration's goal of creating information superhighways for the Nation. It embodies the information infrastructure provisions of the President's technology plan, identified as "Technology for America's Economic Growth," released on February 22nd of this year.

Our goal is to make new networking technologies widely available to the public for applications such as routing medical information at unprecedented speeds, developing network-accessible digital libraries, linking schools and teachers for distance learning, and disseminating the vast stores of government information. The bill will foster the creation of a common set of standards and protocols for use of the high speed network and will finance the development and demonstration of new networking technologies.

Today's hearing is the second of three this subcommittee is planning to obtain the views of a wide range of network providers and users of network services. On April the 27th, we heard from the President's Science Advisor, Dr. Jack Gibbons, who expressed support on behalf of the Administration for the provisions of the bill and indicated that a detailed review of its provisions is now underway by a variety of Federal agencies. We're anticipating a more detailed statement of the views from the Administration sometime later this month.

Also on April 27, testimony was received from a panel of witnesses representing the telecommunications, software, computer, and network hardware industries. These witnesses expressed strong support for the bill and made very thoughtful suggestions for ways to improve it. I was particularly impressed with the breadth of vision these witnesses demonstrated in expressing the potential benefits of high speed networks. They underscored the importance of wide access for everyone to the information superhighway and the need for interconnection and full interoperability of the many components which constitute the information infrastructure.

Today's hearing will focus on provisions of the bill that address specific applications for areas, such as health delivery, education, and access to information in libraries and government agencies. Witnesses with special expertise and experience in these fields have been invited to comment on the provisions of the bill and to recommend additional purposes toward which our research efforts should be focused.

We would like to extend a welcome to each of our witnesses. A number of members of this subcommittee have asked that their statements be included in the record, and, without objection, the record will contain their statements.

And, without objection, the record will also contain the prepared written statements of each of the witnesses who will appear before the Subcommittee this afternoon, and we would welcome the oral summary of each of the witnesses, reflecting in summary form the content of their written statements.

We start this afternoon by welcoming our colleague from New York, who chairs a subcommittee on the House Committee on Education and Labor, Mr. Major Owens, from the State of New York. Major, we welcome you and you may proceed as you wish.

STATEMENT OF HON. MAJOR R. OWENS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW YORK, AND CHAIRMAN, HOUSE SUBCOMMITTEE ON SELECT EDUCATION AND CIVIL RIGHTS

Mr. OWENS. Thank you very much, Mr. Chairman. And I want to congratulate you on this piece of new world order legislation. It's going to be very vital as we move toward the year 2000. And since you're a graduate of the Education and Labor Committee, I'm sure that our interests with respect to education and access, those interests are in very good hands.

For the past 30 years, we've experienced a sea of change and understanding and defining ourselves as reflected in the passage of the Voting Rights Act, the Americans with Disabilities Act, the Civil Rights Act. Each is now the law of the land and serves to enfranchise and empower those Americans who historically have been excluded from the full benefits of citizens.

As the Congress looks forward to the 21st century, we must establish laws—all of our laws should reflect this Nation's diversity. We must look for new challenges and seek new ways to ensure inclusion, not segregation, for our citizens.

Access to information via the telecommunications infrastructure represents an area of critical importance for all Americans. Our future electronic village must contain no barriers. The frontier of the telecommunity must be open to every American. We must ensure that no gateway is closed to any user based on color, sex, race, or religion, or disability.

I'd like to see the plan to develop the Federal role in the High Performance Computing and High Speed Network Act of 1993 strengthened to reflect the diversity that we now recognize as America, and I have submitted a number of amendments in some details which are attached to my statement.

There is a danger. There is a potential chasm growing between those who are information poor and those who are information rich in the emerging 21st century telecommunications networks. Congress must address this issue and we must address it from the start. The Federal role in our partnership with our private sector associates is to require that this diversity be addressed.

Therefore, I come before you today to speak on behalf of the millions of Americans who potentially could become part of the information poor, those who are at risk of being left out of a new electronic communications world that we envisage. I want to ensure that, as Congress directs the Federal Communications Commission and its regulatory capacity to make available to all the people of the United States a rapid, efficient, nationwide communications service, that the phrase "all the people" really means all residents of the United States. I want to ensure that "all the people" includes those persons who have historically been among the underserved in our diverse population. This includes individuals in rural, as well as urban areas. It includes individuals with disabilities or functional limitations of hearing, vision, movement, manipulation, speech, and interpretation of information.

Therefore, we should work to ensure that our citizens that happen to be blind, who happen to be deaf, who happen to have speech or physical disabilities, or who are minorities or old or poor are provided access to all the benefits included in this Act. The Federal role must ensure that we provide for the expansion of opportunities through our investment in networks and high speed computers. Our investment should also improve quality of opportunity, promote full participation, encourage independent living and economic self-sufficiency for every American.

We know that every individual is capable of communicating and knows best how to convey his or her thoughts to others. I expect the Federal role in high speed computing and networking to ensure extension of this basic common courtesy of interacting with people with disabilities that is extended to everyone else in receiving the services, the privileges, and advantages to be offered by our private sector colleagues via the network. We must require that all expressive and receptive electronic communication is readily usable and affordable by persons with disabilities, thereby assuring that the system will be user friendly for every American. We must respect and give primary consideration to the requests of our citizens with functional differences in hearing, vision, movement, manipulation, speech, and interpretation of information, as we develop the technical standards and the protocols. We must address our network capacity for voice synthesis or speech translation, for instance, or for video-phone technology to accommodate the needs of those with disabilities.

We have new technology, of course, which allows all of this to happen. The possibilities for assisting people with disabilities to become a part of this network are infinite. Technology affords us that.

We have an assistive technology bill right now that my committee is in the process of reauthorizing which deals with specific ways in which people with disabilities are able to extend their capacities via the use of technology.

I envisage a universally-accessible network as one constructed to provide electronic access by individuals with disabilities at rates no greater than the rates paid by others with respect to such factors as the duration of use, the time of day, and geographic distance involved in utilizing the network.

We also need to think of electronic means as a variety of formats to accommodate individuals with a full range of functional limitations. We must consider multiplicity or redundancy of channels to ensure that individuals who are blind, for instance, can also hear the data or images that are pulled down from a database. We must consider those who use alternative and augmentative communication devices, voice synthesizers, if you will, when they use electronic communication networks that we envisage. With electronic curve cuts designed for our citizens with disabilities, with built-in circuitry and software that accommodates their needs for multiple channel reception of transmission, we can be sure of a system that is friendly to all.

Real inclusion will not be achieved unless due attention is given to the barriers to access which minorities and individuals with disabilities face. As a librarian, I can't stress enough the importance of public libraries as a vital source of information for urban and rural communities. I would recommend that the bill recognize public libraries as central to a free and comprehensive information delivery system available to everyone, and I do mean public libraries in their entirety. To merely extend this system to take care of the depository libraries is not enough. Public libraries with their branches that reach out to all communities become vital points of access, could be vital points of access, for everybody and it could guarantee that they have the freest possible use of this new innovation.

If Congress establishes a Federal role that includes the diverse needs of every American, we will ensure America's steady march forward. We will renew and rebuild the American dream once again, this time as part of the revolution in electronic communication.

Mr. Chairman, I again congratulate you and I think that this is probably one of the greatest steps forward in terms of government involvement in technological progress that's going to result in concrete services, going to improve business, improve education, facilitate health care and a number of other services that we provide. There's probably nothing equal to this that has come along in the last half century.

I would liken it to the TVA experiment that the government launched and provided so many benefits directly to every person within reach of that project. I do want to stress TVA because there were a lot of debates in the last 10 to 15 years about whether TVA should be privatized. And I want to say at this point that here we start with a venture that is going to be a joint public-private venture. I hope that it always remains a joint public-private venture. I hope that a new concept of public utility will be developed and that always the interests of all Americans, not just those who can pay, those who can afford the rates that are being charged, but if the profitability of the companies that provide software or hardware are in any way connected with this high performance computing and high speed networking situation, their profitability does not become an overriding factor in determining who has access and who does not have access. Libraries can play a major role in guaranteeing that everybody has access at the lowest possible rates.

And I hope that you will consider all the things that I've said, both about serving the people who don't have the money and must be provided for and also the people who don't have the natural abilities or who, for one reason or another, have disabilities and need some special consideration.

Thank you very much for your invitation to testify.

[The prepared statement of Mr. Owens follows:]

TESTIMONY OF HON. MAJOR R. OWENS
CHAIR, SUBCOMMITTEE ON SELECT EDUCATION AND CIVIL RIGHTS

BEFORE

THE SUBCOMMITTEE ON SCIENCE
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,

ON

"THE HIGH PERFORMANCE COMPUTING AND HIGH SPEED
NETWORKING APPLICATIONS ACT OF 1993"
MAY 6, 1993

I would like to thank Chairman Boucher and the other Members of the Subcommittee for giving me the opportunity to testify on an issue of tremendous importance to our nation's competitiveness in the global economy.

In the past thirty years, we have experienced a sea of change in understanding and defining ourselves as reflected in the passage of the Voting Rights Act of 1964, the Americans With Disabilities Act of 1990, and the Civil Rights Act of 1991. Each is now the law of the land and serves to enfranchise and empower those Americans who historically have been excluded from the full benefits of citizenship.

As the Congress looks forward to the twenty-first century, we must establish laws which include and reflect the nation's diversity. We must look for new challenges and seek new ways to ensure inclusion, not segregation, for all citizens. Access to information via the telecommunications infrastructure represents an area of critical importance for all Americans. Our future electronic village must contain no barriers; the frontier of the tele-community must be open to every American; we must ensure that no gateway is closed to any user based on color, sex, race, religion or disability.

I would like to see the plan to develop the federal role in the "High Performance Computing and High Speed Networking Act of 1993" strengthened to reflect the diversity that we now recognize as America. For there is a danger. There is a potential chasm growing between those who are '*information poor*' and those who are *'information rich'* in the emerging 21st century telecommunications networks if Congress does not address the technical and affordability issues from the start. The federal role, in our partnership with our private sector associates, is to require that this diversity be addressed.

Therefore, I come before you today to speak on behalf of the millions of Americans who potentially could become part of *'the information poor'*, those who are at risk of being left out of the new electronic communications world we envision. I want to ensure that as Congress directs the Federal Communications Commission, in its regulatory capacity, to make available, to all the people of the United States, a rapid, efficient, Nation-wide communication service, that 'all the people' means all residents of the United States. I want to be sure that 'all the people' includes those persons who have historically been among the underserved in our diverse population. This includes individuals in rural and urban areas, as well as individuals with disabilities or functional limitations of hearing, vision, movement, manipulation, speech and interpretation of information. Therefore, we should work to ensure that our citizens who happen to be blind, who happen to be deaf, who happen to have speech or physical disabilities, or who are minorities, or old or poor, are provided access to all benefits included in this Act.

The federal role must ensure that we provide for the *expansion of opportunities* through our investment in networks and high speed computers. Our investment must also *improve equality* *of opportunity, promote full participation, encourage independent living and economic self sufficiency* for every American. We know that every individual is capable of communicating, and knows best how to convey his or her thoughts to others. I expect the federal role in high speed computing and networking to ensure extension of this same basic common courtesy of interacting with people with disabilities that is extended to every one else in receiving the services, privileges, and advantages to be offered by our private sector colleagues via the network. We must require that all expressive and receptive electronic communications is readily usable and affordable by persons with disabilities, thereby ensuring that the system will be user friendly for every American, young and old. We must respect and give primary consideration to the requests of our citizens with functional differences in hearing, vision, movement, manipulation, speech and interpretation of information, as we develop technical standards and protocols. We must address how network capacity for voice synthesis or speech translation, for instance, or for videophone technology, will accommodate the needs of those with every disability.

I envision a '*universally accessible network*' as one constructed to provide electronic access by individuals with disabilities at rates no greater than the rates paid by others with respect to such factors as the duration of use, time of day and geographic distance involved in utilizing the network.

We also need to think of "electronic means" as a variety of formats to accommodate individuals with the full range of functional limitations. We must consider *multiplicity or redundancy of channel* to ensure that individuals who are blind, for instance, can also hear the data or images that are "pulled down" from a data base. We must consider those who use alternative and augmentative communication devices, voice synthesizers if you will, when they use the electronic communication networks we envision. With "electronic curb cuts" designed for our citizens with disabilities, with built-in circuitry and software that accommodates their needs for multi-channel reception and transmission, we can be sure of a system friendly to all.

Real inclusion will not be achieved unless due attention is given to the barriers to access which minorities and individuals with disabilities face. As a librarian, I cannot stress enough the importance of public libraries as a vital source of information for urban and rural communities. I would recommend that the bill recognize public libraries as central to a free and comprehensive information delivery system available to everyone.

If Congress establishes a federal role that includes the diverse needs of every American, we will ensure America's steady march forward. We will renew and rebuild the American Dream once again, this time as part of the revolution in electronic communication.

Mr. Chairman, if there is no objection, I would like to submit for the record a list of recommendations which I feel will strengthen the bill.

Mr. BOUCHER. Thank you very much, Major, for those thoughtful comments and taking the time to share them with us today.

I certainly share your vision that as this network is deployed and made available throughout the Nation, that it be accessible to people of all kinds, and for people who have disabilities we need to provide research funding to ensure that their access is guaranteed.

Your comments have been extremely helpful in that regard, both your oral presentation today and also the written comments that you and your staff previously submitted. We'll review those very carefully, and I think we can accommodate your concerns very nicely as we restructure this measure prior to the time of the markup.

So I thank you very much for sharing that with us, and I'd like to recognize at this time the gentleman from New York, Mr. Boehlert.

Mr. OWENS. We look forward to working closely with you.

Mr. BOEHLERT. Thank you very much.

I would just like to echo what the chairman had to say. I, too, am striving for universal access, and I, too, don't want it to be limiting in any way, shape, or manner. For example, when we deal with libraries, I happen to think it's one of the most precious resources in any community. We don't just deal with the depository libraries, but we deal with all of them.

So we're on the same wave length. We want to go in the same direction. We have the same objective in mind. It's a step-by-step process, and, obviously, it's going to be costly—we understand that—but it's worth the investment.

Thank you very much.

Mr. OWENS. Thank you again.

Mr. BOUCHER. Thank you very much, Mr. Owens.

We now welcome our first panel of witnesses: Dr. Don E. Detmer, Professor of Surgery and Business Administration and Vice President for Health Services at the University of Virginia, and Chair of the Committee on Improving Patient Record, Institute of Medicine; Ms. Connie Stout, Director of the Texas Educational Network in Austin, Texas, and Chair for the Consortium for School Networking; Dr. John Masten, the Chief Operating Officer of the New York Public Library in New York City; Dr. Martin Massengale, President of the University of Nebraska and Chairman of the Commission on Information Technologies of the National Association of State Universities and Land Grant Colleges; and Ms. Cynthia Braddon, Vice President of McGraw-Hill, Incorporated, in Washington, DC.

Without objection, the prepared written statements of each of the witnesses will be included in the record. We would welcome your oral summaries, with specific reference to the provisions in the bill that provide for applications of the high speed network for specific purposes. We'd like your views on how we have structured those applications and how they might be modified to better achieve the purposes that I know we all share.

Dr. Detmer, if you're prepared, we'd be pleased to begin with you, and we'll need for you to turn your microphone on.

STATEMENT OF DR. DON E. DETMER, PROFESSOR OF SURGERY AND BUSINESS ADMINISTRATION AND VICE PRESIDENT FOR HEALTH SCIENCE, UNIVERSITY OF VIRGINIA, AND CHAIRMAN, COMMITTEE ON IMPROVING THE PATIENT RECORD, INSTITUTE OF MEDICINE; CONNIE STOUT, DIRECTOR, TEXAS EDUCATIONAL NETWORK, TEXAS EDUCATION AGENCY, AUSTIN, TX, AND CHAIRMAN, CONSORTIUM FOR SCHOOL NETWORKING; JOHN MASTEN, CHIEF OPERATING OFFICER, THE NEW YORK PUBLIC LIBRARY, NEW YORK, NY; DR. MARTIN A. MASSENGALE, PRESIDENT, UNIVERSITY OF NEBRASKA, LINCOLN, NE, AND CHAIRMAN, COMMISSION ON INFORMATION TECHNOLOGIES, NATIONAL ASSOCIATION OF STATE UNIVERSITIES AND LAND GRANT COLLEGES; AND CYNTHIA H. BRADDON, VICE PRESIDENT, McGRAW-HILL, INC., WASHINGTON, DC, REPRESENTING THE INFORMATION INDUSTRY ASSOCIATION

Dr. DETMER. Thank you, Chairman Boucher.

My name is Don Detmer. I'm Professor of Surgery and Vice President and Provost for Health Sciences at the University of Virginia. From 1989 to 1991, I chaired the Institute of Medicine's Committee on Improving the Patient Record, and in 1992 I was a member of its Committee on Assessing Health Care Reform.

I'm pleased to speak today about the High Performance Computing and High Speed Networking Applications Act of 1993 and its implications for health care. This is an historic and critical piece of legislation, and I enthusiastically urge its adoption.

Today, we have better computer-based records of an individual's financial history than we have of her or his medical history. We take it for granted now that one can withdraw money from a bank account across the country within seconds. Yet, it's virtually impossible to get a cumulative list of a child's immunizations or obtain prescriptions for a relative visiting from out of town without directly contacting one or more health professionals.

The information too often cannot be obtained quickly enough to meet even routine needs. Almost always, it can't be found fast enough to be useful in an emergency. As a surgeon, as a medical educator, and even as a soon-to-be grandfather, I find this simply unacceptable.

We lack necessary medical information when we need it and where we need it because we lack an appropriate and up-to-date infrastructure to manage health care information. We desperately need a nationwide system that will link physicians' offices to hospitals, small hospitals to academic health centers and their libraries, community health agencies to hospitals and to one another, even hospitals and clinics to important Federal information sources, including the Centers for Disease Control and the National Library of Medicine.

We need a system that will bring the latest medical information immediately to the practitioner, help us develop life-long records for patient care, allow for electronic consultation among practitioners, perform billing and monitor costs, and capture data for research. Such an infrastructure will also allow patients to assume a more active role in treatment decisions and managing their own illnesses. Patients will be able to access medical information in doctors' offices through public libraries and our home computers. They can report self-monitored test results, such as their blood pressure, to their doctors' offices where an abnormal result will automatically alert the doctor so that serious complications and unnecessary hospitalizations can be avoided.

I believe that future information infrastructures will transform how and where we care for patients, how we teach health professionals, how we do research, and how we manage quality and costs of care. These are powerful technologies, and we are just now getting to the important and exciting part.

Allow me to use the analogy of an interstate highway system built for information. At this point, health care needs not only the network of high speed highways; we need the vehicles, the access ramps, even most of the local roads. We need agreed-upon rules for safe use of the system. We need driver education courses, and we need flexibility in the system to accommodate various vehicles with a variety of travel itineraries. In other words, in addition to developing and deploying the technologies themselves, we will need resources to develop computer-based patient records, create user friendly interfaces, set up institutional, local, and regional electronic networks; establish the rules, regulations, laws, and encoding methods to protect confidentiality and system security; set standards for the content and format of the data to be transmitted; and train more experts in medical informatics.

All of these issues are fully outlined in the 1991 Institute of Medicine report, "The Computer-Based Patient Record: an Essential Technology for Health Care." I've included with my written testimony a recent article from issues in Science and Technology that reviews the conclusions of the IOM Committee and describes other activities related to computer-based patient records.

Progress is being made, but not at the speed needed. We desperately need sizable demonstration projects. At the University of Virginia, we are so strongly convinced that this is the right way to move that we're already dedicating time and resources to a regional experiment in information management. We are exploring building a regional information infrastructure to support the delivery of health care throughout the Blue Ridge region of central Virginia. We seek to demonstrate how various kinds of information flow among network providers. This infrastructure will help us build an integrated, comprehensive health care system with our academic health center as a hub and resource for education and service.

Demonstration projects like this must go beyond simply automating current procedures to help us do faster what we already do. The opportunity is before us wholly to redesign our work and, thus, achieve greater productivity in caring for patients, teaching students, and conducting research.

This legislation provides the much needed impetus for us and others like us across the country. Our progress otherwise will be painfully slow. The activities identified in section 309 will contribute strikingly to high performance computing and high speed networking in health care, and I urge you not to focus exclusively on technology development and ignore the people issues associated with its implementation. Greater support for the training of health informatics professionals through the National Library of Medicine and other public health service agencies is urgently needed.

In addition, because the computer-based patient record is so crucial to the future of health care and the information management infrastructure, I would recommend explicit recognition of the Computer-Based Patient Record Institute and involvement of it in tracking and coordinating the high performance computing and high speed networking projects explicitly related to computer-based patient records.

Finally, I urge that the authorization levels outlined in the bill be fully appropriated because such funding can be responsibly applied to great benefit. Health care reform tops our Nation's policy agenda because it holds such significant implications for quality of life and national competitiveness. Reform cannot succeed, however, without the supporting information management infrastructure. Section 309 of this legislation is an essential part of the prescription to treat and restore color to the cheeks of our health care system. Speaking for myself, H.R. 1757 is just what the doctor ordered.

I thank you for the opportunity to share my convictions on this topic, and I'll be happy to answer your questions.

[The prepared statement of Dr. Detmer follows:]

WRITTEN STATEMENT OF DON E. DETMER, M.D.[1]
BEFORE THE SUBCOMMITTEE ON SCIENCE

Committee on Science, Space, and Technology
U.S. House of Representatives

May 6, 1993

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[1] Don E. Detmer, M.D., is Professor of Surgery and Business Administration and Vice President and Provost for Health Sciences, University of Virginia, Charlottesville, Virginia. Dr. Detmer was chair of the Institute of Medicine (IOM) Committee on Improving the Patient Record (1989-1991) and a member of the IOM Committee on Assessing Health Care Reform (1992).

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A recent article from *Issues in Science and Technology* follows this text. The article reviews the conclusions of the IOM patient record committee and describes other activities related to computer-based patient records.

Don E. Detmer, M.D.
Vice President and Provost for Health Sciences
Professor of Surgery
Professor of Business Administration
University of Virginia

Dr. Detmer received his medical degree from the University of Kansas in 1965 and completed his surgical internship and residency at Johns Hopkins University Hospital, the National Institutes of Health, and Duke University between 1965 and 1972. He then took a health policy fellowship at the Institute of Medicine, National Academy of Sciences, and the Harvard Business School Program in Health Systems Management. From 1973 to 1984, he was on the faculty of the University of Wisconsin-Madison, becoming a full professor of surgery and preventive medicine in 1980. In 1984, he became vice president for health sciences, at the University of Utah. He assumed the vice presidency for health sciences at the University of Virginia in 1988. Dr. Detmer is a member of the Institute of Medicine and its board on health care studies. Formerly chair of the board of regents of the National Library of Medicine, he is currently a trustee of the China Medical Board plus a member of other boards relating to health care. He is the author of numerous articles and book chapters on surgery, health policy, and academic health center leadership.

DON E. DETMER
ELAINE B. STEEN

Patient Records in the Information Age

If you're out of town and need cash, an automatic teller machine can instantly determine if you have money in your account and let you withdraw what you need. If you apply for a loan, the lender can quickly get access to your credit history to help determine your reliability. If the Internal Revenue Service is reviewing your tax return and needs to know how much was withheld from your salary during the year, the information is readily available. But if you need emergency medical care and the physician needs information on your medical history, it is highly unlikely that it can be found and made available promptly. In fact, much of the information necessary to understand the workings of the U.S. health care system is not to be found no matter how long one is willing to wait. And without better access to medical data, the health care system will be hampered in its efforts to provide better care to individuals and to enhance the overall effectiveness of the entire system.

> *Broad cooperation*
> *is needed*
> *to help institute*
> *a national*
> *computer-based*
> *system*
> *of medical data.*

The information-management challenge experienced by health care professionals and institutions is growing daily. At least three factors contribute to this growth. First, health care practitioners must master and track an ever-increasing base of medical knowledge. MEDLINE, the computer data base of biomedical literature, grows by approximately 360,000 new articles per year. Second, patient records include more data as patients live longer, experience more chronic disease, undergo a greater variety of tests, and have more encounters with health care providers. Third, the demand for patient data is increasing. In addition to supporting the diagnostic and therapeutic work of clinicians, patient data are used to document patient risk factors, expectations, and satisfaction with treatment; to perform quality assurance, risk management, cost monitoring, and utilization review; to identify emerging public health problems; to track adverse reactions to pharmaceuticals; to document

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Don E. Detmer, vice president and provost for health sciences at the University of Virginia, was chairman of the Institute of Medicine's Patient Record Committee. Elaine B. Steen, assistant to the vice president and provost for health sciences, was staff officer for the IOM committee.

services provided for billing and legal purposes; and to assess the effectiveness of new technologies and procedures.

The users of patient data include not only physicians, nurses, and other health care practitioners but also virtually everyone associated with the health care delivery system. Patients themselves are increasingly likely to be interested in their records as they become more informed consumers of health care services. Administrators of health care institutions seek data to manage the quality and costs of services provided as well as to project staff, budget, and facility needs and identify opportunities for new programs. Insurance companies, other third party payers, and employers who pay for health benefits seek patient data to monitor the frequency, cost, and quality of health care services provided to their subscribers or employees. Health services researchers seek access to aggregated patient data to study patient outcomes, variations in practice patterns, or appropriateness of alternative treatments for a particular condition. Policymakers seek data to monitor the performance of health care institutions, to evaluate coverage decisions for federal and state insurance programs, and to evaluate the availability of health resources to meet current and future needs.

Patient records are a linchpin of information management in health care, but traditional medical records have not kept pace with the changes in health care and cannot satisfy many of the new demands placed on them. Despite the broad diffusion of computer technology, most patient records today exist only on paper and are often inaccessible, inaccurate, incomplete, illegible, disorganized, not secure, and not integrated into the various settings of care. Computerizing current paper records would help, but it would not meet all current and future user needs. Existing patient files do not have a standard form, do not integrate data from multiple care settings, and do not include all the types of data needed to enhance patient care and better manage the system. Given the broad array of users and uses of patient records and the new technologies available to support them, a new concept of the patient record is needed.

Defining data needs

In 1989, the Institute of Medicine (IOM) convened a Committee on Improving the Patient Record that articulated a vision for "an electronic patient record specifically designed to support users by providing access to complete and accurate data, alerts, reminders, clinical decision support systems, and other aids." As a first step, the committee described what an ideal computer-based patient record (CPR) system would entail: ease of operation, convenient locations of workstations in the patient care setting, 24-hour availability, rapid response time, and simultaneous use of a given record by multiple users.

Security is a critical requirement of CPR systems and depends on technology and user behavior. Systems must track when users log on and off the system, lock out attempted log-ons after failed attempts, require users to update their passwords on a regular basis, and be able to generate secondary records that exclude patient identifiers and contain only those data needed by nonclinical data users.

The ability to connect the computer systems within and beyond an institution is another essential component of CPR systems. For example, physicians would be able to request laboratory tests, order prescriptions, refer patients for consultation, or admit patients to the local hospital from the CPR workstations in their offices. Information would also flow into the CPR system from other sources. Laboratory test results, consultation notes, and discharge summaries would be sent electronically to the physician's office and filed automatically in the patient's record. Similarly, bills could be generated automatically at the end of each patient visit and sent electronically each day to third-party payers. Relevant data could be automatically reported to the Centers for Disease Control, the Food and Drug Administration, or tumor registries, rather than requiring practitioners to complete forms manually.

CPRs should offer users assistance with routine tasks, thereby increasing the time physicians and other health professionals can spend with patients. For example, users would be able to generate with the stroke of a key routine forms such as school or insurance examinations and patient instructions for a range of illnesses or treatments. Perhaps the most significant feature of the CPR environment would be the availability of clinical decision supports. Repeated laboratory test results could easily be transformed into a graph, thus facilitating recognition of a pattern. Decision algorithms and clinical practice guidelines would be available to assist in diagnostic and treatment decisions. Access to current medical knowledge would be facilitated by linkage with MEDLINE and other literature and bibliographic data bases. On-line, clinical reminders would support preventive medicine by informing practitioners or patients of needed vaccinations or tests. Clinical alerts, identified by subroutines embedded in the computer's program, would prompt practitioners if a patient's lab results revealed a dangerous trend or if incompatible drugs were prescribed.

In addition to improving the quality of care by providing better information to physicians, CPRs should also contribute to the moderation of health care costs in several ways. Direct entry of laboratory test results should reduce the frequency of redundant testing that occurs when previous test results cannot be found. Productivity is likely to be enhanced as time need not be spent tracking down missing records or missing data or waiting for records that are in use elsewhere. Since data need be recorded only once in the computer record, redundant data entry can be eliminated.

Finally, CPR systems will support the advancement of medical knowledge by making improved patient care data available for clinical and health services research. Data that are maintained in CPR systems are likely to be more easily and less expensively collected and aggregated since data will no longer need to be manually abstracted from records and entered into research data bases. And CPRs offer a means of bringing research results directly to practitioners.

Making it happen

Although health care lags behind other industries in applying computer technology for data storage and retrieval, some activity in this arena has begun. Automated patient records can be found in various stages of development in some health maintenance organizations, outpatient clinics, hospitals, and multihospital systems. In addition, some physicians are using clinical decision support systems that provide guidance in areas such as general medical diagnosis, drug therapy decisions, and the management of chemotherapy for patients participating in formal clinical trials. But nothing currently in use possesses the scope and scale of the envisioned CPR. How can we move from the present inconsistent and frequently archaic information-management practices and technology toward widespread and compatible CPR systems?

Developing a comprehensive CPR system represents a significant, but not insurmountable, technological challenge. Progress is needed in four major areas: Facile user interfaces must be developed so that practitioners will not find it cumbersome to use CPRs; system security technology and protocols must be enhanced to protect the accuracy and confidentiality of patient data; local, regional, and national networking capabilities must be built so that linkages among CPR systems can be set and data standards must be established so that data can be shared between CPR systems and used for various purposes.

Equally important, though perhaps more difficult to overcome, are the nontechnological impediments to CPR development: the lack of a clearly articulated and widely agreed-upon definition of what a CPR is and what the performance expectations of its users are for vendors; high research and development costs and an uncertain market; an inadequate number of experts trained in medical informatics; the public's concern about protecting confidentiality of patient data; the issue of patient data ownership; and ambiguity in and inconsistencies among state laws related to patient records.

Organized or overt resistance to CPRs is unlikely, but subtle resistance is likely on several fronts. Individuals who believe that their jobs are threatened by the change and health care workers who are reluctant to learn new skills may be unwilling participants. Among those who stand to benefit from CPR implementation, competing and sometimes conflicting interests must be addressed. Vendors who must play a key role in the success of CPR development must strike a balance among cooperating to facilitate development, avoiding antitrust violations, and pursuing profits. Finally, individual institutions may be hesitant to invest in a CPR system due to high costs and as yet unquantified benefits. Overcoming these barriers will require coordination among the many organizations and individuals interested in CPRs and a decisionmaking process that will be accepted throughout the health care system. For this reason, the IOM patient record committee's major recommendation was the establishment of a Computer-based Patient Record Institute (CPRI) to promote and facilitate development, implementation, and dissemination of the CPR.

In the spring of 1991, the American Health Information Management Association (formerly the American Medical Record Association), American Hospital Association, American Medical Association, American Nursing Association, and U.S. Chamber of Commerce formed a coalition for establishment of the CPRI. The CPRI was incorporated in January 1992 and held its first annual meeting in July 1992. The CPRI currently has 22 organizational members representing the health care professions, insurers, payers (for example, employers), information systems and service vendors, and government, as well as a data base of interested groups that includes over 700 organizations. Aware of the major barriers to implementation, the CPRI has established four workgroups: CPR demonstration projects; confidentiality, privacy, and legislation; codes and structure; and education.

The CPRI is not alone in its efforts to advance CPRs. The federal government is demonstrating increasing commitment to improving information management in health care. In early 1991, the General Accounting Office (GAO) issued a report on the benefits of automating medical report systems. Since the GAO and IOM reports were released, at least two bills introduced in Congress have explicitly addressed the automation of patient data systems by requiring hospitals participating in Medicare to be able to submit their claims electronically and by authorizing funds to develop model systems "to facilitate gathering of health care cost, quality, and outcome data." Several federal agencies—particularly the Agency for Health Care Policy Research, the Health Care Financing Administration, the National Library of Medicine, and the Department of Veterans Affairs—were actively involved in the IOM patient record study and continue to support improved information management and CPR development through involvement of their staff in CPRI workgroups, by funding research related to or directly associated with CPRs, and by disseminating information about the value of and ways to accomplish information management in health care settings.

In addition, in November 1991, Secretary of Health and Human Services (HHS) Louis Sullivan convened national health care leaders to discuss the challenges of reducing administrative costs in the U.S. health care system. At the forum, three health care industry-led workgroups were created—the Workgroup for Electronic Data Interchange (WEDI), the Task Force on Patient Information, and the Workgroup on Administrative Costs and Benefits. In its July 1992 report, WEDI presented a vision and recommendations that are consistent with the efforts of CPRI. WEDI will continue in existence as a collaborative effort among health care industry participants and will report to the secretary of HHS each year on industry progress. The other two workgroups are still conducting their deliberations. The potentially complementary efforts of these three workgroups and of the CPRI must be coordinated by their respective leadership to avoid redundancy and possible conflict.

Despite the extensive attention that CPRs have been receiving, we will not have them in place and ready for use fast enough. Health care could benefit from the use of CPRs today, and certainly any reformed health care system will rely heavily on the information-management capabilities that CPRs offer.

President Clinton's new technology initiative includes increased investment in high-performance computing and networking applications to improve the provision of health care by "furnishing health care providers and their patients with better, more accurate, and more timely information." This initiative may provide a significant boost to CPR development efforts by acknowledging the importance of building an information-management infrastructure to support health care and by providing the level of funding that is needed to support large-scale CPR demonstration projects.

But just as technology alone cannot overcome the challenges involved in improving patient records, money alone will not get us to the CPR. The many federal agencies and private-sector organizations that are involved in CPR issues—particularly open discussions regarding standards—must coordinate their efforts. In the short term, the newly appointed president of the CPRI may be well advised to convene a "CPR summit." In the long term, if CPRI is to fulfill this coordinating role, it must increase its visibility and credibility by strengthening its financial base and producing tangible results that move us toward the ultimate goal of CPRs.

Mr. **BOUCHER**. Thank you very much, Dr. Detmer. We'll have some questions shortly. We'll hear from the other witnesses first. Ms. Stout?

Ms. **STOUT**. Thank you, Chairman Boucher.

I'm Connie Stout. I'm the Director of the Texas Education Network, TENET. For the past number of years, I have worked to study and analyze the use of electronic communication within schools. To develop this testimony, I sent a request over the Internet. And so my comments here reflect the words of thousands of educators.

The traditional school environment is an amazingly self-contained one. It has a historic tradition which limits interaction between students and teachers in different classes and at different grade levels. The benefits extend beyond what is termed as distance learning. Distance learning is only one part of the puzzle of educational reform. We need a system that will allow us to track students. We have more than 6,000 students that leave Texas every March and April to end up in schools in Minnesota alone.

The electronic networks foster the development of learning communities among professionals who address problems and find solutions together. Yet, until recently, the K-12 community has not been able to enjoy the benefits of information networks. Yet, we cannot expect our professional educators to meet the educational needs of the 21st century with out-of-date tools, services, or support. The movement toward educational reform fits well with the distributive communication systems.

In Texas, because we have a State-supported public education network, more than 21,000 public and private educators use this network. They come on at a rate of 120,000 logons per month. Such access has supported the professional growth of these educators in Texas. TENET has already supported the impact on teaching and learning and it has demonstrated the need for broadening the communications capabilities, and it has contributed to the private sector. We are the largest single user of 800 phone lines within our State. All of our circuits are purchased through the local phone companies.

But let me give you a little history on this. Beginning in 1985, the agency contracted for services for a private network through a commercial service. By the time we ended the service with that contract with them in 1991, only 3,000 educators and less than half of our districts had utilized the service. It was mostly to share administrative work.

We formed an advisory committee to assess needs and formulate a plan. This plan was taken to our State legislature, and part of the bill that resulted was to formulate a statewide telecommunications network.

We sent out a Request for a Proposal to receive support from the commercial sector. The proposal was withdrawn because of the costs that were prohibitive.

With the awareness of a national thrust on the networking, the analysis of what was going on, we formulated our network on the basis of the Texas Higher Education Network. It optimized both cost-effectiveness and the level of service—to bring the level of service to the K-12 students and educators.

And it also did another thing. It provided an important link between K–12 and post-secondary institutions. It took advantage of the networking expertise and the resources in the higher education community.

The Higher Education Network is providing connectivity to a majority of our post-secondary institutions in Texas, it is a regional National Science Foundation network. Several other states are using the same model, including California, Virginia, and Florida.

Chairman Boucher, you and your committee are to be commended for envisioning the needs of the Nation as you conceive the High Performance and High Speed Networking Applications Act. It has the potential to further leverage existing State resources and build partnerships with the local community and private sector by stimulating the development of these networking resources.

It targets several areas which will remove barriers that K–12 education has faced in the past. These are addressed in your sections on connections, training, and applications development, and I would like to speak to those directly.

The connections program is actually a research initiative. And, as such, the NSF is the appropriate agency to address these areas. To be successful, the connections program must be directly linked with training. We need the Federal Government to support leadership to help facilitate the support, though, of education tariffs for all states. The realization of the benefits for telecommunication technology will only occur when technology has been institutionalized as a part of schooling. Education has not been able to afford the telephone lines to link their schools, and they have had to rely on gifts. But charity will not scale to address national problems. Adequate educational tariffs are the only mechanisms that will provide a stable base for the needed long-term growth.

Equity is another issue. These information resources cannot be limited to the elite. Otherwise, we will disenfranchise our whole population.

In the area of collaboration with non-Federal entities, the example that we have in Texas really speaks to that. The THEnet and TENET were not built with Federal dollars, though. We've built them because of a recognition of a national vision.

In the applications for education, again, the National Science Foundation has a wealth of experience in conducting research on the applications of advanced technologies, and this experience will be a valuable resource.

Extensive research will need to be integrated into the social and the organizational structure of schools. Evolving communication needs will require research on the many complex policy issues.

There is a need to leverage support from other Federal agencies, specifically, the Department of Education, in order to build an information infrastructure to achieve the systemic reform within our educational system that we all desire. These projects should include research in all areas of education which would be touched by this technology. Yes, we need to reach more than math and science educations to achieve our goals, and a close partnership with the Department of Education is a must.

Teachers need to have access to the intuitive tools. Projects should be included for the development of tools which have been identified and called for by educators. An African proverb states that it requires the whole village to educate a single child, and it is imperative for all areas of the educational enterprise to be included.

TENET is succeeding in our State for two reasons. One, the access is simple and the training is widespread. In training there are more—there are two important areas. It's more than just teachers, but all workers in the educational community, including administrators and support staff. Those who conduct training need to be included—be represented from all sectors, not just the librarians, although they are a valuable part of this whole training process.

Within Texas, we found that master trainers should not be limited to one specific group of individuals, but they must represent a cross-section of the stakeholders: math teachers, school teachers—science teachers, school administrators, school board members, as well as your computer coordinators. We have found that in order for the technology to be integrated the training must be provided by those who see the benefit from similar perspectives. To disseminate the training, we, too, must—look at widespread dissemination through other State agencies, through the Federal agencies, such as the Cooperative Extension Service, and you might also consider museums and professional associations.

The bill addresses pre-service courses, but it must include courses for the professional development of the teachers and our administrators. Our administrators are the change agents in schools today.

Applications for government information—parents need to see a return on their tax dollars. When the children talk about accessing information from the NASA space link database, they see that return. When teachers use AskERIC, they see that return. It is imperative that education has access to these numerous information resources and databases. Commercial providers can certainly add value to it, but a large amount of this information must be made available.

In the area of restriction on the use of the test-bed networks, I do have concern that the language has the potential to severely limit the Federal and State government action. Does this mean that the K–12 education no longer has access to the NSFnet as we currently know it? I hope not.

TENET and those educators need to access a public education network. We cannot afford a private toll road with metered tariffs. Those who have resources should benefit from those who are further from the—should not be different from those who are further from road. Those people would be disenfranchised. We risk the potential of developing a society polarized into the information rich and information poor. We have already seen in Texas we cannot afford a private commercial network. It is important to the Nation's economy in the nineties to have the development of a public communications system. It is critical to the success of the information age and the knowledge workers.

The Federal- and state-supported information highway will serve—prove fertile ground for marketing information providers for them to develop and market their resources.

You're correct in supporting broad band connectivity where we can access high speed as needed. Limitations on these needs could be problematic in the future. Educational applications might not appear at this time to merit high band width. However, when the use arrives—and it will—the education community will need access to that space.

In the area of copyright, we need to address these problems. We need to provide a means which permits the development for numerous publishers and information providers of resources. The most frightening image is that the conduit and the content would be provided by single sources. This cannot be.

As a general note, the bill has several application areas, but they cannot be considered in isolation. Fifty-six other State agencies in Texas share the common infrastructure provided by the THEnet backbone without direct Federal dollars. It has created a synergy. We now see examples of child neurologists working with nurse practitioners in schools to identify the need of fetal alcohol syndrome children. They are working with the curriculum developers to create programs to meet the needs of those children. With close collaboration and partnerships among all the entities—Federal, state, and private sector—there is unlimited potential in the development of the NREN program.

Children are 25 percent of our population. They are 100 percent of our future.

Thank you.

[The prepared statement of Ms. Stout follows:]

United States House of Representatives

Committee on Science, Space and Technology
Subcommittee on Science

Hearing on H.R. 1757, the High Performance Computing and High Speed Networking Applications Act of 1993

May 6, 1993

Connie Stout, Director of the Texas Education Network (TENET),
Chair, Consortium for School Networking (CoSN)
Board member of the International Society for Technology in Education (ISTE)

Thank you Chairman Boucher, distinguished members of the subcommittee and guests. I am Connie Stout, the director of the Texas Education Network (TENET). I serve as the chairperson of the Consortium for School Networking (CoSN). The Consortium for School Networking is a membership organization of institutions formed to further the development and use of computer network technology in K-12 education. Our members represent educational, institutional, and commercial organizations with an interest in advancing the state of the art in all aspects of electronic computer networks.

I am also a member of the Board of the International Society for Technology in Education (ISTE). The International Society for Technology in Education is a society of educators who share an interest in instructional and administrative applications of technology which enhances the educational enterprise.

I am delighted to represent the elementary and secondary educational community alongside colleagues who come to this hearing to represent their constituencies in the health care, post-secondary education, publishing, and library communities. To develop this testimony, I sent a request over the Internet to educators around the country. My comments reflect the thoughts of hundreds of educators.

The traditional school environment is an amazingly self-contained, isolated one. It has a historic tradition which limits interaction between students and teachers in different classes and grade levels. The walls of the classroom have isolated the teacher in a culture which doesn't support frequent interactions among colleagues within the same campus or with other adults outside the building. Electronic networks can break down these walls, giving students and teachers access to resources both within and without the educational system not available to them before.

The skills deemed necessary for both the teacher and learner change as they are connected to a larger community of resources and people through tools such as the Internet. Teachers become researchers and managers of information who team teach as they design the educational outcomes with the help of their remotely located colleagues and mentors from many sectors of the community. Resources are not limited to those found within textbooks or within the campus. Students need to be able to articulate problems, access and identify necessary resources, and collaborate with peers around the world as they solve them. The roles of both the teacher and learner change as both explore new information resources and ways of learning.

Electronic networks foster the development of "learning communities" among professionals who address problems and find solutions together. Such communities can be found in subject area departments within the campus, within school districts and among professional associations. Without such support networks, educators fall back on traditional, familiar practices or feel lost, and eventually leave the profession. Electronic support networks have the ability to extend these learning communities to the isolated professional educator.

The k-12 educational community has not been able to enjoy the benefits of information networks. The technology has so far mostly been limited to the early adopters, to those educators who had special funding or those with access to special single purpose administrative networks. This severely limited the development of an understanding of the educational value of incorporating electronic communications into daily use. Since there were a number of different networks and the cost was seen as a barrier, a void existed as educators were compelled to articulate the benefits of incorporating telecommunications into the workplace. This inhibited administrative support to fund further study of the benefits of telecomputing technologies. We cannot expect our professional educators to meet the educational needs of the 21st Century with out-of-date tools, services and support.

The Internet is a very democratic communications system in which peers communicate with peers. The hierarchical culture of the institution of schooling runs counter to this system. However, the movement toward educational reform and site-based shared decision making fits well with distributed communications systems.

In Texas, because we have a state supported public education network, more than 21,000 educators dialogue with subject matter experts, collaborate with their colleagues, and provide children with authentic opportunities to gather data, communicate with others not in the same locale and access the myriad of commercial and publicly developed information available via the network. Such access has supported the professional growth of Texas educators; it has made students more tolerant and empathetic. TENET has already had an impact on teaching and learning. It has demonstrated the need for broadened communications capabilities. And it has contributed to the private sector: TENET is the largest consumer of 800-number telephone service in the state of Texas.

The Texas Education Agency long ago recognized the need for effective and low-cost communication among and between the more than 6,400 public school campuses, the 20 regional education service centers, colleges and universities, and other educational professionals in Texas. Beginning in 1985, the Agency contracted for services on a commercial network. During the time the Agency used the commercial service, only 3,000 educators in approximately 500 of the 1,058 school districts used the network --mostly to share limited administrative information.

In 1987, an advisory committee was appointed to assess the needs of the State and develop a strategic plan for the use of technology in the State. In November of 1988, the State Board of Education adopted the 1988 - 2000 Long-Range Plan for Technology. Incorporated within the plan was a request to establish a K-12 statewide communications network to link all school districts and their campuses. The requests were incorporated in 1989 into Senate Bill 650 which was passed by the 71st Legislature. Senate Bill 650 (Section 14.042 of the Texas Education Code) authorized the establishment and maintenance of an electronic information transfer system, the Texas Education Network (TENET).

It was felt that a complete communications infrastructure design with a comprehensive approach was necessary to overcome a number of barriers to use by K-12 education. In Texas, a Request for Proposal process was initially tried seeking network alternatives from the commercial sector. The proposal was withdrawn because of the excessive cost involved. Since the process did not result in an award, alternatives were considered.

At the same time Texas was considering alternatives, the High-Performance Computing Act was signed into law. The act called for the development of the National Research and Education Network (NREN). This gave rise to the hope that a national education netwoking resource could be established upon Internet protocols.

With an awareness of the national networking thrust and on the basis of an analysis of the available networking alternatives, it was decided that the Texas Education Network should be developed in partnership with the Texas Higher Education network (THEnet). This option would maximize both cost-effectiveness and the level of services to Texas K-12 students and educators. It provided an important link between K-12 and postsecondary institutions. It also took advantage of the networking expertise and resources found in the higher education community.

The Texas Higher Education Network (THEnet), providing connectivity to the majority of the major post-secondary institutions in the state, is a NSF regional network connected to thousands of other networks worldwide through the Internet. Several other states, including California, Virginia, and Florida, are using similar models to bring connectivity to their public school educators. This model permits partnerships to be established that bring the broad spectrum of the educational community together to address levels of service delivery not possible before.

Chairman Boucher, you and your committee are to be commended for envisioning the needs of the Nation as you conceive the High Performance and High Speed Networking Applications Act of 1993. H.R. 1757 has the potential to further the leverage existing state resources and build partnerships with the local community and the private sector, by stimulating the development of these networking resources. These network resources need to be identified at a level of technology that is likely to produce the most benefits. H.R. 1757 targets several areas which will remove barriers that K-12 educators have faced in the past. These are addressed in your sections on connections, training, and applications development.

I would like to address some comments directly to the bill.

"SEC. 306. NETWORK ACCESS.
"(a) CONNECTIONS PROGRAM.__
It is important as resources are made available that they reach all sectors of the community.

Several points need to be clarified.
The Connections program is actually a research initiative, and as such the NSF is the appropriate agency to address these issues. Creating an educational support system out of these diverse entities is not something that policymakers can set down and cost out without pilot studies and trials of alternatives. It very much has to do with multiple applications - with school system and integration of functions at each level including business, libraries, museums, and others.

In the era of the global economy, access to distance-binding resources such as networking is an equity issue. These information resources cannot be limited to the elite. Limiting access to only a few will disenfranchise a whole sector of the population. The National Research and Education Network Program, NREN, brings the possibility that a national infrastructure will be built which will enable all sectors of the community to have access to its benefits.

The connections program acknowledges that today's knowledge workers in schools lack access to a key instrument for reform to the educational system, the telephone. Some commercial providers have taken the lead to bring this technology into the schools. New England Telephone and the Rhode Island Division of Public Utilities have an agreement to provide phone lines for classroom access to telecommunications. The public utility commissions in a number of states provide their educators with an educational tariff. We need the Federal government to provide the leadership to help facilitate the support of educational tariffs in all states. This is more than an issue of just one phone line in a school; it implies building an infrastructure which will support access from every educator and student's desktop. The realization of the benefits of telecommunications technology will only occur when the technology has been institutionalized as part of schooling. Private gifts and charitable contributions are welcome and can extend the impact of public funds, but they cannot be expected to substantially address problems of national scope. Appropriate educational tariffs, devised to accommodate school system planning cycles and budgets, will provide a stable base for planning and long-term growth.

"(c) COLLABORATION WITH NON-FEDERAL ENTITIES.

Collaboration with State and local governments provides a means for the government to act both as a catalyst and as a force multiplier in order to accomplish shared goals. The direction set forth by the original NREN bill has been a catalyst for numerous states to design their telecommunication network around an open-systems design to permit greatest levels of interconnectivity.

"SEC. 308. APPLICATIONS FOR EDUCATION.

The National Science Foundation has a wealth of experience in conducting research on applications of advanced technology. This experience will be a valuable resource. Extensive research will be needed to integrate applications into the social and organizational structure of schools. Evolving communications needs will require research on many complex policy issues. The changes seen in the information infrastructure will impact more than just software and hardware. There is a need to leverage support from other federal agencies, specifically the Department of Education, the National Aeronautics and Space Administration, and entities of the Department of Commerce, in order to build an information infrastructure which will be integrated within our educational system and have the features we all desire.

It will be important that projects are designed to reflect input from educators in the field. These projects should include research in all areas of education which would be touched by this technology. Yes, we need to reach more than mathematics and science education to achieve our goals. A close partnership with the Department of Education can aid in this effort.

Demonstration projects which do not contain the research and analysis need to appropriately decide how the network would scale up or ramp up to universal access will have little value. As the Department of Commerce plays its designated leadership role in developing access to the National Information Infrastructure, lessons learned from the NREN program should be used as models for all concerned agencies in the Federal government to work together.

Teachers need access to intuitive tools which would enable them to access the power of the technology. Projects should include the development of tools which have been identified and called for by educators.

An African proverb states that it requires a whole village to educate a single child. Our whole community should be included in the design of the network It is imperative for all areas of the educational enterprise to be included for the telecommunications technology to be institutionalized as a part of the national thrust for education reform.

Cynthia Garrett, a teacher in Texas, notes that TENET is succeeding in our state because access is simple and training has been widespread. An appropriate initiative to assure adequate training is critical to the success of the NREN program. This training needs to extend to all sectors of the community. We have trained Master Trainers who include math teachers, science teachers, librarians, school administrators, and school board members, as well as computer coordinators. Master Trainers are not limited to one specific group of individuals, they represent a cross-section of the stakeholders. We have found that in order for the technology to be integrated, training is best provided by those who see the benefit from a similar perspective.

Network and applications training should be made available for all stakeholders. It cannot be limited to one segment of the population.

To disseminate training, consideration should be given to involving state agencies as well as other federal agencies such as the Cooperative Extension Service of the U.S. Department of Agriculture. They have an ongoing relationship with local communities in every county in the Nation and support network technologies. Other constituencies that have useful training models for consideration include museums and libraries.

Training programs should include in-service courses as well as pre-service courses. We currently have 225,000 teachers in Texas, and more than 12,000 enter the teaching field each year with zero years experience. There must be training programs to accommodate experienced teachers in the field. Extending training to inservice groups will permit a strong alliance between those studying to become teachers and those teachers currently practicing.

"SEC. 311. APPLICATIONS FOR GOVERNMENT INFORMATION.
Access to Federal Government information has been a tremendous benefit to educators. Parents see a return on their tax dollars when their children talk of accessing the NASA SpaceLink database and getting up-to-date information. Access to accurate real-time data has provided students with the ability to state hypotheses, conduct analyses and validate their findings on a short time

frame. Government becomes meaningful when students are able to read the White House press releases as they occur from their classrooms.

There are a number of possible educational projects which involve students in the use of government-supported information sources. One might be to give students studying economics access to government economic data, e.g. statistics on unemployment, trade, etc. These could be read in and reconciled with simulation program results, inserted in reports, and used for community oriented projects. Projects like these would make students feel involved with their government.

The use of the Internet has enabled students to dialogue directly with scientists. Paul Smith, an Australian researcher in Antarctica, wrote to a third grade class in Wynn Elementary School in Las Vegas, Nevada. Bruce Dally, their teacher, noted that this unique learning experience gave the children a look at geography, weather conditions, and plant life in Antarctica which would have been impossible for the children to visualize using only a textbook.

AskERIC is a program designed to assist educators in finding information on educational research. TENET provides access to AskERIC as a direct menu item. From their classrooms and homes in Texas, teachers have been able to find resources on alternative assessment, block scheduling, the affects of school climate on discipline and many others. Teachers have found this federally supported project invaluable to them.

It is imperative that education have access to these numerous information resources and databases.

"SEC. 102(d) RESTRICTION ON USE OF TESTBED NETWORKS.__

Section 102(d) [NREN] restricts testbed networks from being used to "provide services that could otherwise be provided satisfactorily using privately operated networks." A concern is raised by the term "satisfactorily", which seems highly unclear. What does "satisfactorily" mean? Is the focus on technical specifications, price, other considerations, or some or all of the above? Are the services prohibited basic network functions such as access and connection, or are they the "information services" that the networks are designated to facilitate? Can one "provide service" to oneself, or is the concern provision of a "service" by one entity for another, probably for fee? This section leaves education with real concerns.

I do have some concern with the language which has the potential to severely limit Federal and state government actions. Secretary of Labor Robert Reich noted that "In the 1950s, the nation committed itself to building a modern transportation system." We need to have support from Federal and state sectors to support the modern communications system. The investment in the communications infrastructure is one of the most important investments our nation will make in the future. The highway system of the 50's was built in collaboration with the private sector as their resources were used to build the highway. This enabled thousands of commercial business to spring up along the highways as numerous communities developed near the roadways. The federally supported interstate highway was an important stimulus to the developing economy.

Equally important to the nation's economy in the 90s is the development of the public communications system. It is critical to the success of the Information Age and the knowledge workers. Our educators and students could be among the first to benefit from such a system. The federal and state supported public Information Highways could provide fertile ground for many information providers to develop and market their resources to the many communities that will gather there. However, should the public Information Highway become a private toll-road with metered tariffs, those who have resources would benefit while those who are further from the road would be disenfranchised. We risk the potential of developing a society polarized into the information rich and the information poor.

Limitations placed on the use of the high speed network are also problematic. Perhaps we could consider an analogy similar to the High Occupancy Vehicle Lanes (HOV) which permit access to the high speed lines based upon application. Educational applications at this time may not give the appearance of meriting high bandwidth; however when those usages arise – and they will – the educational community will need access to that space.

Section 102 (6) should be rephrased to read approximately as follows: "develop approaches to the provision of copyrighted materials over networks which will encourage commercial, nonprofit and government organizations to make such materials available at reasonable cost and profit." Mechanisms such as site licenses, shareware schemes etc., need to be encouraged; these will provide means for the publishing community to consider alternatives to textbooks for the delivery of educational information.

As a general note, each application area cannot be considered in isolation. A common infrastructure needs to be developed, otherwise no one will be able to afford networking. Instead of building a separate network for K-12 education, the NREN will help educational agencies at all levels in the United States pool our resources. Fifty-six other state agencies share the common infrastructure provided by THEnet's backbone in Texas. As usage grows, so will the infrastructure. Using this approach a certain synergy has been created. We now see examples of child neurologists working with practitioners in the school to identify the needs of fetal alcohol syndrome children. They are working with curriculum developers to create programs to meet the needs of these children. With close collaboration and partnerships among all entities, there is unlimited potential in the development of the NREN program.

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THENET

by Tracy LaQuey Parker

The Texas Higher Education Network (THEnet) was formed in 1986 through a combination of networking efforts at Texas A&M University, the University of Houston, the University of Texas Health Science Center at San Antonio (UTHSCSA), and the University of Texas System. Covering the state of Texas, with a link to the Instituto Tecnologico y de Estudios Superiores de Monterrey in Monterrey, Mexico, THEnet connects more than 60 academic and research institutions. THEnet's goal is to provide and advance the electronic exchange of information in support of the teaching, research, development, and related collaborative activities of the Texas higher education and research communities.

Administration and Membership

THEnet was initially managed by the computing services staff of Texas A&M University. With the creation of the University of Texas System Network (UTSN) in 1986, the UT System Office of Telecommunication Services (OTS) networking staff assumed network management duties. OTS provides both network information center (NIC) and network operations center (NOC) services to THEnet member institutions.

Membership in THEnet is divided into three categories: Class A, degree-granting institutions of higher education and their associated research institutions; Class B, nonprofit research and governmental organizations not associated with a Class A member; and Class C, industrial research organizations sponsored by a Class A member. Currently, THEnet consists of 39 Class A members, 13 Class B members, and 10 Class C members.

Protocols, Topology, and Hardware

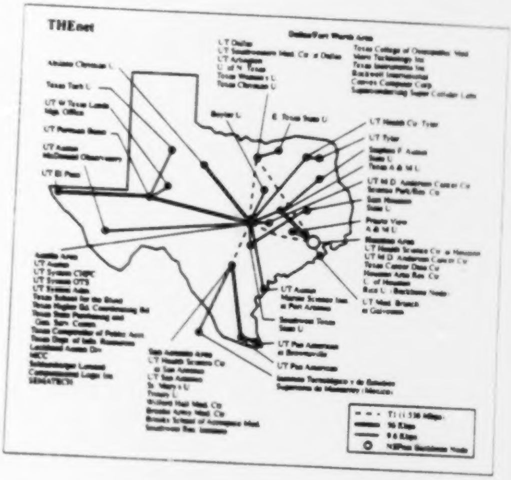
THEnet is a network of physical connections between and within organizations making various use of IP, DECnet, SNA, NJE, OSI, and compressed digital video to provide researchers, faculty, and students with the networking tools that they need.

THEnet uses cisco Systems AGS routers between its hub sites at Dallas, Houston, Austin, and San Antonio. Other sites are connected to the hubs with a wide variety of equipment. Most of the data links are implemented with 1.5-Mbps leased digital data circuits. THEnet introduced its first full T1 data circuits in 1989, when in cooperation with Sesquinet, it established a T1 triangle interconnecting cisco routers located at UT Dallas, UT Austin, and Rice University. THEnet includes other T1 connections: UT Austin has T1 connections to UTHSCSA and M.D. Anderson Cancer Center in Houston, UT Dallas to UT Arlington and UT Southwest Medical Center, UTHSCSA to UT San Antonio and UT Pan American at Edinburg, and UT Pan Am at Edinburg to UT Pan American at Brownsville.

External Network Connectivity

THEnet's Internet connectivity dates back as far as 1973, when UT Austin established a connection to the ARPANET (the Defense Advanced Research Projects Agency Network). In April 1989, THEnet was officially designated an NSF regional network, gaining access to the NSFNET backbone through the NSS (Nodal Switching Subsystem) located at Rice University in Houston.

THEnet is connected to the Space Physics Analysis Network (SPAN) by DECnet routers located at UT Austin and NASA Johnson Space Center. Since the DECnet address spaces of the two networks conflict, a technique known as poor-man's routing (PMR) is generally used to allow hosts in each network to communicate with


THEnet
Dallas/Fort Worth Area
UT Dallas
UT Southwestern Med. Ctr. at Dallas
UT Arlington
U. of N. Texas
Texas Woman's U.
Texas Christian U.
Texas College of Osteopathic Med.
Texas Instruments Inc
Rockwell International
Convex Computer Corp
Superconducting Super Collider Lab
Abilene Christian U.
Texas Tech U.
UT W Texas Lands Mgt. Office
UT Permian Basin
UT Austin McDonald Observatory
UT El Paso
Baylor U.
E. Texas State U.
UT Health Ctr. Tyler
UT Tyler
Stephen F. Austin State U.
Texas A & M U.
UT M.D. Anderson Cancer Ctr Science Park/Res. Ctr
Sam Houston State U.
Prairie View A & M U.
Houston Area
UT Health Science Ctr. at Houston
UT M.D. Anderson Cancer Ctr
Texas Cancer Data Ctr
Houston Area Res. Ctr
U. of Houston
Rice U. (Backbone Node)
UT Med. Branch at Galveston
Austin Area
UT Austin
UT System CHPC
UT System OTS
UT System Adm.
Texas School for the Blind
Texas Higher Ed. Coordinating Bd
Texas State Purchasing and Gen. Serv. Comm.
Texas Comptroller of Public Acct
Texas Dept. of Info. Resources
Lockheed Austin Div
MCC
Schlumberger Limited
SEMATECH
UT Austin Marine Science Inst. at Port Aransas
Southwest Texas State U.
UT Pan American at Brownsville
UT Pan American
Instituto Tecnologico y de Estudios Superiores de Monterrey (Mexico)
San Antonio Area
UT Health Science Ctr at San Antonio
UT San Antonio
St. Mary's U.
Trinity U.
Wilford Hall Med. Ctr
Brooke Army Med. Ctr
Brooks School of Aerospace Med.
Southwest Res. Institute
T1 (1.536 Mbps)
56 Kbps
9.6 Kbps
NSFnet Backbone Node

BEST COPY AVAILABLE

each other via intermediate gateway nodes.

However, DECnet address translation software was written at UT Austin for cisco Systems multiprotocol routers and is being used in production mode between THEnet and SPAN. The software allows selected SPAN hosts to be mapped into the THEnet address space, eliminating the need to use PMR.

Gateways to the High Energy Physics Network (HEPnet) are in operation at Texas A&M University (TAMU) and at the Superconduction Super Collider Laboratory (SSC). A VAXstation II at TAMU with a low-speed link to the Fermi National Accelerator Laboratory (FERMILAB) is used as a DECnet PMR gateway between HEPnet and THEnet. At the SSC, which is directly on HEPnet, a cisco Systems router running UT Austin's DECnet address translation software maps selected THEnet nodes into HEPnet and HEPnet nodes into THEnet.

Additionally, the SSC and UT Austin are both ESnet backbone sites. ESnet is the multiprotocol (IP, DECnet, and X.25) successor network to HEPnet and MFEnet.

THEnet's external BITNET connectivity is provided by Rice University via their participation in the BITNET II project (NJE over the TCP/IP-based Internet). Currently, the University of Houston (UH) and UT Austin connect to Rice via NJE over TCP. The rest of THEnet's BITNET nodes connect to UH, Rice, or UT Austin via a multiconnected mesh topology using NJE over TCP or NJE over DECnet.

Gateway connectivity to the Telenet X.25 public data network is provided by the UT System Office of Telecommunication Service to THEnet members on a cost-recovery basis. Currently, inbound X.29 terminal communication and VAX PSI mail gateway services are supported.

Network Services

Network information and operating services are provided through OTS. Informative documents and host and contact lists are available on the THEnet NIC host, nic.the.net via anonymous FTP, and THENIC (DECnet) via default DECnet file access. See the file THENET.INDEX for a list of available documents.

The User's Directory of Computer Networks, a directory of hosts, domains, and contacts on major academic and research networks, has been an annual publication of OTS since 1987. The 1990 edition was recently published by Digital Press.

Additionally, OTS hosts an annual Texas State Telecommunications and Networking Conference during which a variety of informative presentations are given. THEnet members also meet annually at THEnet Managers Meetings to discuss technical and policy issues. OTS is currently planning to offer tutorials on network configuration and routing to THEnet members in March 1991.

For further information on THEnet, send a message to info@nic.the.net. ■

TENET

by Connie Stout

In August 1991, the Texas Education Agency established the Texas Education Network (TENET) to serve as an electronic information transfer system for the state's educators and students. The Texas education system services a diverse student population. Within the state there are more than 1,050 school districts, which have enrollments ranging from 190,000 students to fewer than 10. Since TENET began operation, more than 4,300 users have accessed the network, averaging 10,500 logins per week.

TENET users access the Internet via the Texas Higher Education Network (THEnet), an NSF regional network that provides Internet connections for most of the colleges and universities in Texas. Through this regional connection to the Internet, TENET offers access to a variety of resources, including on-line library catalogues, educational computer archives, public databases, and instructional hypermedia libraries. The use of THEnet is in line with national efforts to link higher education with public education and offers the potential for expanded access over the Internet.

TENET also provides access to electronic mail gateways at many other networks, including AppleLink, CompuServe, MCI mail, AT&T mail, FrEdMail and Fidonet. These connections are available to Texas educators without an additional charge.

Configuration

The configuration of TENET is based on a distributed design. Each local host consists of a series of message processing and storage units (MPS). Each MPS is a UNIX system that has 24 Megabytes of memory, 1 Gigabyte of disk, and a backup tape. The central host is located at the University of Texas System Office of Telecommunication Services. Local phone access, as well as 800-line service, is provided in Austin, Texas. Seven other message processing and storage (MPS) computer systems are distributed across the state at university sites to store messages and support applications.

Services

The Texas Education Agency, in collaboration with the Texas Center for Educational Technology, designed TENET training courses, which are conducted at 20 regional education service centers throughout Texas. The Computation Center at the University of Texas, Austin, provides help-desk services for TENET. Applications on the system are designed and implemented by The University of Texas System Office of Telecommunication Services in cooperation with the Texas Education Agency.

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Conferencing

TENET uses USENET conferencing software to create Texas-specific conferences. The TENET conferences are moderated by teachers, so that as telecommunications are introduced in the classroom, the moderators can create an environment for learning and can establish the protocols of network etiquette. All of the moderators on TENET are trained to guide conference participants as they explore the world of telecommunications.

Collaboration

TENET telecommunications projects bring students, teachers, and members of the network community together from across state and national boundaries. TENET supports collaboration between K-12 educators and post-secondary educators in several ways. For a nominal fee of $5 per year and no on-line cost, Texas administrators, teachers, and students can extend their network communication to include educators and students around the world. TENET members have access to the on-line services of libraries at major universities, such as University of Texas, Texas A&M, University of California, University of H[illegible]ai, and University of Colorado. Members also have access to resources such as NASA's Spacelink in Huntsville, Alabama. Through Spacelink, teachers are able to communicate with astronauts and scientists as well as retrieve classroom materials for their own use. Among other TENET resources are UPI news, CNN Newsroom lessons, and Newsweek Lessons. In 1992, the network will provide access to an on-line encyclopedia and a study skills guide. ■

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Overview

The intended purpose of the study was to provide data to persons responsible for making informed policy, leadership and management decisions regarding the future operation of TENET. The information was gathered from a variety of sources during the period 5/15/92 through 11/15/92. Subjective and objective data gathering techniques were employed, and observations and recommendations are based heavily on both types of information.

The study consists of three primary sections, each unique in its approach to describing the status of The Texas Education Network (TENET) after a year of operation:

Section One was prepared by Dr. Jane David, Bay Area Research Group, Palo Alto, CA, and addresses issues of teaching and learning based on data gained from TENET users during focus groups facilitated by all members of the study team and from the results of a user survey administered on line.

Section Two was prepared by Dr. Gloria G. Frazier, WEB Associates, Naples, FL, the prime contractor for the study, and is an explication and discussion of the results of the online user survey which presents implications of the results and suggestions for further investigation. This section contains an item by item commentary with visual representations.

Section Three was prepared by Deneen Frazier, AtWork Networks, Arlington, VA, and is a comparison of TENET with other statewide networks together with a discussion of TENET in the national context. Included in this section is a matrix comparison of TENET with four other statewide telecommunications networks serving their respective education communities.

Conclusions in the form of recommendations are presented at the end of the study. These conclusions are drawn from the information gained as a result of the study and are filtered through the professional knowledge and experience of each of the preparers.

TEACHING AND LEARNING WITH TENET

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Within a few months of its introduction, educators' use of TENET vastly exceeded even the highest expectations. Before the end of TENET's first year in existence, over 10,000 educators signed onto the system according to the Texas Education Agency (TEA). This response attests to the speed with which TEA launched the system, putting in place the hardware and software as well as training and support for users, and attracting users to the system. The remarkable response also attests to the value offered by TENET; educators sign on because it is valuable professionally.

TENET is intended to facilitate learning and communication for educators and students. It is based on a vision of telecommunication technology as a powerful tool for student learning, teacher and administrator professional development, and increased productivity and efficiency in communication--up, down, and across all levels of the public school system.

This report focuses on how teachers are using TENET to enhance student learning. TENET is one of several potentially powerful technologies able to help educators equip students with the knowledge and thinking skills they will need to function as productive citizens in the upcoming century. But the potential of such technologies is realized only when educators have access to hardware and software and access to the knowledge and skills needed to use the technology in ways that transform learning experiences for students.

TENET has the potential to provide such access. Through the capabilities of electronic mail, conferencing, access to databases, news sources, and other networks, educators can communicate with each other and stay abreast of the latest best practices in their field. Similarly, students can have direct access to simulations designed to stimulate thinking and problem solving skills, vast libraries of information, experts, and colleagues across Texas and the country. Telecommunications can overcome problems of teacher isolation within schools, communication with colleagues across schools and districts, separation of teachers and administrators, administrators at different levels of the system, and limited on-site resources such as library books.

The findings described are based on face-to-face interviews, an online survey posted on TENET, telephone interviews, school-site interviews, and observations of videos created by school sites. The interview sample included over 200 educators attending a national technology conference held in Texas during July, 1992. These educators, who volunteered to be part of our sample, included teachers, school and district administrators, regional service center staff, and TEA staff. The survey responses are a non-random sample of 408 TENET users--those who chose to respond. These data were enhanced by selected online follow-up questions.

The sample is purposefully biased towards early adopters--leading edge educators who tend to be among the first to experiment with innovations. By focusing on those who have used TENET the most, we were able to maximize lessons about both the strengths and weaknesses of TENET in its first year. Future evaluations will require a more representative sample of all types of users.

From these data, a clear picture of the first year uses and usefulness of TENET emerges Overall, TENET has been received with unabashed enthusiasm, in spite of educators unfamiliarity with telecommunications, limited availability of training, and some technical limitations of the system For students and teachers alike, it opens a new and constantly growing world of information and colleagues The combination of introductory training from the regional centers and on-line support eases access for many teachers, even those inexperienced with computer technology

Teachers are the primary users of TENET, they use TENET for learning activities with students and for their own professional development and productivity Administrators use TENET for both productivity and administrative purposes as well as for providing staff development and other support for teachers Over half of the survey respondents reported using TENET more than three hours a week and 40% of those reported more than nine hours weekly use Over 70% of the survey respondents sign on at least once a day Half of these occur from the workplace, typically after school, and half from home On a seven-point scale describing the usefulness of TENET from 1 = "useless" to 7 = "has revolutionized my work", 92% of the respondents ranked TENET as 6 or 7 In a similar vein, 70% report that they have used TENET more often than they expected to when they originally signed up

We have chosen to use many of the respondents' own words to communicate how teachers and administrators use TENET and their attitudes towards it The responses were remarkably consistent, therefore the examples and quotations represent a class of responses and are not unique in their content

We look first at how teachers are using TENET directly with students and how TENET changes the kinds of teaching and learning in classrooms We then turn to the ways in which TENET provides direct benefits to educators, through professional development and increased productivity, which makes possible changes in curriculum and instruction Finally we discuss the barriers to more extensive uses of TENET as TENET moves from its infancy to a fully effective system for all educators

Instructional Uses of TENET

Teachers and other faculty members offered a wide variety of examples of instructional uses of TENET with students across all grade levels, subjects, and all kinds of students including handicapped and gifted Teachers often cited uses around current events and their ability to access up-to-the-minute information, news, as well as download materials and ideas for lessons plans on current news For example, in a number of classrooms around the state teachers used TENET for a unit on space during shuttle lift off They got up-to-the-minute data from NASA over the network Students went home able to show off to their parents because they had learned the facts before their parents

The immediacy of the information, and the fact that it is real, appeals to students and teachers In one class, students, looking up whether there had been any earthquakes recently, found one was occurring at that very moment *It became a living breathing subject TENET has helped with motivation for student and teacher*

Classes also engage in simulations not logistically possible without electronic connectivity For example, one school had an economic summit on TENET where students, teachers, county judge, university faculty all asked and answered questions about economics on line *We saw how excited the kids got!* In another school, teachers

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noted that they were isolated and could not afford the time or money for field trips *TENET helps connect us to the rest of Texas We are saving money and going more places with TENET*

Teachers, administrators, and students enjoy immediate access to information on what is happening in the State Legislature and reports on State Board of Education activities Both teachers and students find that TENET vastly increases access to research materials this is especially appreciated in small schools where libraries have limited collections

> *I can communicate effectively with other [educators] about any topic I gather expert advice from others who have tried methods and learned from their mistakes The students and I can travel to other places without ever leaving my library and obtain much more information I don't think I could do without TENET now that I have had the wonderful opportunity to work with it*

Teachers commented that students take more care with their writing when they are going to transmit something electronically Electronic communication encourages students to practice and improve writing skills

> *I have seen children's writing improve One student said, "You have to spell right or your friend can't read what you say!" I think our children are learning how to learn They are keeping current on events They are learning to think, to draw conclusions, to see the world in a different light*

Moreover, students feel differently about themselves when they communicate as an invisible party Students may find themselves tutoring adults--even teachers, students become experts which in turn leads to increased self-confidence This fact is particularly salient for students whose physical characteristics have led to uncomfortable or negative reactions in face-to-face encounters, for example

> *TENET is equally available to ALL children Our handicapped children as well as our gifted and talented students can use TENET We have one child with a physically deformed body She has a key-pal To her key-pal she is just a beautiful third grader who loves life and is a joy to know She feels so very important because she feels she is very special to someone They love to write For all we know, many of our children may be writing handicapped children*

> *I've used telecommunications with blind students They need adaptive equipment to read the screen and produce information in Braille It's wonderful Most of the time they do not identify themselves as blind*

Respondents also gave examples of problem solving made possible through communication with other individuals or groups in other schools with similar problems For example, in one school students and faculty were concerned about disruptions that had occurred during the previous year's graduation Through TENET, students and teachers communicated with their counterparts in another school that had experienced similar problems and solved them *It brings schools together*

The examples of instructional uses cited by teachers are as varied as their situations Teachers also emphasized that the more they become familiar with TENET, the more ways they discover to use it. From mentors for students to real-time science experiments to adult penpals for students with language or mental impairments, the uses are seemingly endless. *I seem to develop more uses each day as I continue to learn more about the real potential that TENET offers the classroom teacher.*

EXHIBIT 1

TENET: A POWERFUL INSTRUCTIONAL TOOL

How can a modem and some extra telephone wire transform learning opportunities for students? Teachers cited a range of uses of TENET with their students including:

- access to information otherwise unavailable
- access to current, unfolding events worldwide
- ability to download instructional materials
- simulations to enhance thinking and real-world skills
- research projects
- access to expert advice
- immediate feedback
- opportunities for practice (especially writing)
- collaborative problem solving
- access to people around the world

An educator from a Regional Education Service Center offered a compelling description of the instructional power of TENET in the context of goals for student learning in Texas:

Our Commissioner of Education has charged us with providing an education that is equitable and involves "real-world skills." Since we are trying to prepare kids for a world of which we can't conceive, our job as educators MUST be to teach kids how to learn, how to access information, and how to accept change. TENET is certainly a tool that can help us with these and is indeed a real world skill. Additionally, TENET can help us address the issue of equity of resources in Texas. Many of the school districts in my region are small and lack the resources and specialized personnel of the larger districts. TENET can help balance those scales. The smaller districts can now access NASA, leave messages for the astronauts, browse around in libraries larger than any they will ever be able to visit, do research in states/countries that they can even dream of visiting, discuss the super conducting supercollider project with the physicist in charge, discuss world ecology with students in countries around the world, read world and national news that appears in newspapers that are not available in their small towns, work on projects as equals and collaborators with those in urban areas, and change the way they feel about the size of their world. This will create students that we could not create otherwise. This is a new education and instruction.

Teacher Development and Productivity

The kinds of instructional uses of TENET described above are only possible when teachers have access to TENET have the knowledge to use it in exciting instructional ways and have the time to take advantage of these opportunities where they exist Therefore the key to future widespread changes in teaching and learning is access to learning opportunities and time for teachers

Regional Education Service Center staff provide training for teachers on how to use TENET through introductory workshops and follow-up support The quality of both varies by region according to our teacher respondents and on the support of district and school administrators Training opportunities are also constrained by the availability of equipment Despite such problems teachers demonstrate commitment to learn to use TENET for example

> In a small rural district eight teachers scrambled to gather enough equipment to support a day of training from the Regional Education Service Center (ESC) representative One teacher brought a modem from home another brought 200 feet of phone wire They strung the wire down the hall and connected three computers to the modem and phone line so that the ESC trainer could teach them how to use TENET

TENET provides opportunities for professional development which fit the characteristics of best practices in adult learning access to colleagues. models of exemplary lessons. access to expert advice and most importantly. access to all the above when needed. not at a pre-specified scheduled time at a remote location *[TENET] has enabled me to share ideas problem solutions. and experience with a number of educators both in Texas and across the country*

Teachers are able to post questions and receive answers from colleagues across the state and beyond Teachers can consult with each other on ideas for lessons and experiences with particular approaches In fact given how isolated teachers are from each other in classrooms during the school day it is easier to consult with colleagues via TENET because time and place no longer matter Moreover. the definition of immediate colleague shifts from one's school to a much larger set of teachers across the entire state and beyond Teachers also participate in ongoing discussions around current topics from curriculum development in social studies to issues in restructuring schools For teachers in small rural schools. the opportunity to exchange ideas with colleagues becomes a reality for the first time *It's hard for our rural school to have up-to-date materials TENET has helped me learn about materials that I can use with students that other teachers say are good*

Teachers can keep up with the latest practices in education through exchanges with other teachers involvement in discussion groups. scanning of new materials. access to libraries and other information sources for learning and for conducting research *I have found a revitalization in my own teaching process that I attribute to utilizing TENET*

TENET also serves as an efficient form of communication to announce particular events and staff development activities Activities can be scheduled quickly because announcements can be distributed instantaneously Regional Education Service Center staff describe increased communication between ESC and district staff. and among ESCs

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as a major benefit of TENET TENET also facilitates communication among teachers and administrators in the same region

Teachers and administrators enjoy the access TENET provides to legislative and state board of education updates professional association information, as well as educational developments across the state Many cited increased awareness of and participation in policy discussions and legislative affairs concerning the Texas education community

Asked how TENET was useful one teacher described a range of ways in which TENET increased his own teaching ability

- *It offers me many interesting ideas to bring to the classroom*
- *It offers me up to date information to supplement dated textbooks*
- *It broadens my understanding of world affairs*
- *It keeps me abreast of the latest developments in education*
- *It connects me with people all over the world*

In the comments offered were descriptions of a number of ways in which TENET stretches available time--partly by inspiring extensive at-home use and partly by increasing productivity Teachers and service center staff developers report extensive home use of TENET However, the extensive at-home use reflects users who have their own computers and modems at home--which is not the case for the vast majority of teachers and administrators Nevertheless some teachers have purchased their own modems in order to have access to TENET at home because access to school is limited by the lack of phone lines Typically, teachers must go to the library or the office to have access to a phone line and modem

TENET also increases productivity by providing more efficient ways to communicate which in turn frees up time for activities tied more directly to teaching and learning The ability to plan and notify people of events saves time as well as money, both can occur without the costs of meeting time, travel, and postage costs Telephone tag is replaced by the ability to receive and send messages when convenient Staff developers noted their ability to respond individually to educators' questions within a day because TENET gave them access to people well beyond and before the school day Moreover, their access to people was not dependent on their physical location
Because of the size of the regions ESC personnel reported increased opportunities to service the districts for which they were responsible without curtailing their travel schedules or daily responsibilities This feature is equally appealing and reassuring to instructional personnel when the need for a classroom substitute arises
One teacher described her use of TENET to communicate daily with her class and with the substitute teacher while she was away

> *I had to be [away] for a week to take my son to a specialist I needed to be able to communicate with my substitute, to keep up with my classes and to send completed lessons to them We used the e-mail of TENET to transmit questions my students had, as well as questions that my substitute had to me I answered and returned them as well as other assignments, hints on programs, and test questions back I checked in three times daily during that week I was away from my classroom*

EXHIBIT 2

ENSURING A QUALITY WORKFORCE THROUGH TENET

Developing real-world skills and reaching world-class standards requires a major transformation in how teachers teach and how administrators support those new ways of teaching and learning. Traditional forms of professional development, based on a limited workshop training model, do not address the need for teachers and administrators to learn to do their jobs in dramatically different ways. For teachers to create learning environments that actively engage students in meaningful tasks, they need access to examples of best practices, curriculum content, and the experience of colleagues--and the time to learn and to communicate. Administrators need ways of understanding the kinds of supports teachers need; ongoing communication with teachers is critical for this understanding. Similarly, for districts to function as effective organizations, they need easy access to information, each other, and their counterparts across the state and in the TEA. TENET carries the potential to create a quality workforce and enhance productivity through increased and more efficient communication and through opening new avenues of professional development to teachers and administrators in ways not possible under existing top-down models of training. Already educators have cited innumerable ways in which TENET has contributed to their professional growth and efficiency.

TENET INCREASES PROFESSIONAL DEVELOPMENT OPPORTUNITIES

- exchange ideas
- solve problems with colleagues
- share experiences
- consult with colleagues anywhere
- join discussions on restructuring and other current topics
- create curriculum
- scan new materials
- access libraries
- access state and association information
- access Regional Education Service Center staff
- access current events

TENET INCREASES PRODUCTIVITY

- communicate more efficiently (no telephone tag)
- eliminate travel time (to library, to colleagues)
- speed up notification of events
- receive individually tailored answers to questions
- communicate in new ways in real time
- stretch available time through at-home access to TENET
- download curriculum materials
- stay up-to-date on district and state actions

Barriers to Use

Although TENET holds enormous potential, as illustrated by the variety of effective uses already discovered during its first year, there are barriers that must be overcome to realize its full potential. These barriers are of three broad types: technical, access, and traditions. These categories of barriers are intertwined; for example, solving the problem of having phone lines in the classroom may require administrators to think very differently about what teachers do.

Technical Barriers

The technical barriers are in some ways the easiest to solve. TENET users complained about the limitations of Kermit, especially for downloading information, and its ability to interface with other software programs. Users would like to see TENET supported by multiple protocols. TENET's current structure also does not support simultaneous group conversation desirable for brainstorming and decision making.

Users also noted that phone lines are often busy, suggesting the need for more lines. Some had complaints about speed, although many attributed the slowness to their modem, not the system. A few noted that TENET communication is easily disrupted by storms.

In spite of these complaints, technical barriers did not discourage people from using TENET. In fact, very few described TENET as too cumbersome or difficult.

The following section puts these barriers in the context of other telecommunications systems and projects the future technical demands that TENET will face.

Access Barriers

Educators cannot take advantage of TENET if they do not have access to it. Access includes having both the necessary equipment at hand and the necessary know-how. At a minimum, educators need a computer, a modem, a phone line, and initial training. Yet in most schools, this is not available, and where the hardware exists, it is not readily accessible to teachers. For example, there may be only one phone line and one modem in the main office or library. Ultimately, teachers need access in their classrooms as do administrators in their offices.

Introductory training is usually available through the ESC to those who request it and are willing to go to some lengths to acquire the necessary hardware for hands-on learning. Users, however, suggested a need for two or three different phases of training. First, background information and guidance on how to get set up. Then, an introductory hands-on session on how to use TENET, preferably at the school site with the equipment that will be used. Then, after some independent use where problems are inevitably discovered, a follow-up on-site session. With experts--and more experienced colleagues--to answer questions online, the rest of the training can occur on an as-needed, individually tailored basis. There appears, also, to be a substantial interest on the part of end users to become more active in creating peer counseling and training structures locally. Many users expressed a strong desire to be empowered to train others at their schools and districts. There was a strong sentiment toward increasing dramatically the incentives and viability for more building and district level trainers.

and training session availability, rather than having to depend on a *circuit rider* from the ESC.

Users also noted that many people with whom they wish to communicate are not yet accessible through TENET; obviously, as more join, this barrier will disappear. A superintendent told the following story:

> A superintendent and an administrator from another district were having a conversation during which the administrator asked the superintendent for a copy of a report he had. The superintendent asked for his TENET address. When he found the administrator didn't have one, he told the administrator he would have to get the report elsewhere since he couldn't receive it electronically.

By far, the biggest constraint on access is lack of time. Lack of time is exacerbated by not having the necessary hardware readily accessible. Obviously, the more convenient the equipment--ideally in the classroom and at home--the less time it takes to use it. But lack of time is also in the nature of teachers' jobs. With responsibilities for students during most of the school day, and daily grading and preparation activities, there is little time to explore the vast sources of information and expertise available through TENET.

Traditions as Barriers

Access and technical limitations are not the only barriers to more, and more effective uses of TENET. Teachers and administrators are accustomed to certain ways of operating and communicating. TENET offers new and different ways of organizing work, communicating, and learning. Because they are new and different, however, they do not come naturally to people. For example, TENET facilitates communication between teachers and administrators, but for those unaccustomed to communicating, it is the barrier of traditional relationships that must be overcome.

TENET has the power to make possible a whole new conception of professional development--one driven by the needs and preferences of those requesting help. Yet for teachers and administrators familiar with only one mode of professional development--usually a menu of workshops-- it takes time to realize that professional development can occur at any time through TENET's ability to provide information and link people. TENET enables teachers and students to independently seek information and expands greatly the universe of people from whom they can get ideas and feedback--from peers to experts.

> *We could never go back to teaching without it. [TENET] has been a wake up call for other teachers.*

Similarly, for teachers trained primarily in direct instruction and other teacher-centered pedagogy, it is traditions of practice that limit their instructional uses of TENET. TENET provides a powerful tool to help teachers, administrators, and students shift their mindsets from looking to be told what to do to creating and sharing solutions.

> *[TENET] has become a part of life for me. It is one of the things that will keep me from retiring for a long time. It brings a great deal of joy to my life to see the light in the students' eyes and the joy on their faces as they are involved with TENET.*

Telecommunications represents the leading edge of the revolution beginning inside schools across America but its potential will be realized only as attitudes and traditions begin to shift to encompass a new vision of interactive teaching and learning for the twenty-first century

TENET will make Texas the leader in telecommunication

ONLINE TENET USER SURVEY

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WEB Associates

This section describes data collected by an online survey posted on TENET and by followup online inquiries to selected respondents to clarify, verify and explore responses. Portions of this data were used in anecdotal form or referenced in the previous section of this report.

Survey Instrument and Methodology

The survey instrument was designed as an extension of an existing "Pre-Use Questionnaire" which was voluntarily requested from all TENET users when they registered for the network. It was intended that those submissions would form baseline data with which data obtained from a post-administration of the same instrument could be compared for an identical population. Items were added to reflect the fact that a user had been registered on the network for a period of time, to gain additional insights into areas such as most frequent sign-on location and users with disabilities and to encourage respondents to supply more extended responses and anecdotal data. Items regarding length of time as a TENET user and actual TENET use versus expected TENET use were added after it became clear that because of the way pre-use demographic data was stored it would be beyond the scope of the study to gain post-administration data on the identical group of users who had submitted a pre-use questionnaire. The program administrator and evaluator decided that a random sample from online users would be sufficient to determine a useful user profile without benefit of baseline data.

The evaluation study was designed to profile the most active user group, from whom a substantial amount could be learned regarding the network's acceptance by and usefulness for a broad spectrum of users, rather than attempting a representative sample which, because of the newness of the network, would include a large number of users with minimal or no TENET experience. By gathering the evaluation data online, responses from minimal users or users without the skills or equipment necessary to respond online, to download or print the survey were limited. Inexperienced users were given the option of obtaining a survey form by mail or from other sources.

Internal considerations prevented a network-wide announcement of the survey until only two weeks before the close of the survey period. Therefore, the instrument was located online in news groups and conference areas which might not be visited regularly or at all by minimal or incidental users. Shortly before the close of the survey period, it was possible to place a general "banner" announcement which all users encountered when they signed on TENET. The banner generated 200 new responses within two weeks. Another technical enhancement made it possible to mail a request to complete the survey to those who had completed the pre-use questionnaire prior to April 30, 1992, once their e-mail addresses were manually identified from TENET records.

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Survey Results

General Observations

The total number of responses (408) was lower than expected This may be due to the relative inaccessibility of the survey to other than experienced, frequent users of more than e-mail, considering the relative inexperience of nearly half the user pool at navigating news groups or conferences or downloading files It is also not clear that all trainers and Regional Education Service Centers actively promoted the survey or encouraged responses

Although the differences were statistically insignificant, the responses received late in the period after the sign-on banner appeared were from users who had been registered on TENET for a shorter period of time, who rated themselves as infrequent or inexperienced or (the largest percentage increase) from teachers without workplace access to TENET

Percentage of anonymous responses was lower than expected, based on comparable studies which gave respondents an opportunity to freely address issues

There were no completely negative responses Although most respondents identified problems, all respondents offered overall a positive appraisal of TENET's usefulness and viability

Although the evaluation study is a sample of less than 5% of network users, and the assumption had been made that the sample of presumably experienced and frequent users would be skewed, the demographics of the sample match almost exactly the demographics of the total TENET user population

Description of Respondents

Eighty-six percent of the survey sample was composed of respondents directly involved with K-12 education, and because those educators are the primary focus for TENET, Table 1 and Graph A examine in greater detail the K-12 respondents

Table 1 is a profile of the entire survey sample, with an emphasis on the public / private aspect of the responses The data show clearly that TENET is servicing the population for which it was designed and, at the same time, has been sufficiently accessible by those impacting K-12 education to serve as a unique meeting place for discussion of the needs of the Texas education community

Graph A compares the school, district and state level responses by four general work category descriptions curriculum and instruction, administration, clerical and staff and health and human services The data, again, clearly reinforce that TENET is serving those most closely connected to student learning

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Table 1

PROFILE OF RESPONDENTS*

Public K-12 (86%):

School	54 0%	District	19 0%	State	13 0%
Teacher	44 0%	Sup t /Ass't . Assoc	3 0%	Regional ESC	8 0%
Library/Resource	6 0%	Administration	6 0%	TEA	3 0%
Principal/Ass t	3 0%	Curr Coord	3 0%	Library	1 5%
Clerical/Staff	5%	Clerical/Staff	5 0%	Special Schools	5%
Counselor	5%	Medical/Health	1 0%		
		School Board	1 0%		

% of school respondents	
Senior High	58 0%
Jr/Mid/Int	28 0%
Elementary	14 0%

Other K-12 (1%)

Private (5%) / Parochial (5%)
Teacher (5%) / Principal (5%)

Higher Education (5%)

Public (4%) / Private and Parochial (1%)
Instruction and Research (3%) / Library (1%) / Student (5%) / Administration (5%)

Private Sector (2%)

Education Publishing and Consulting (1%). Software (5%). Aerospace (5%)

Public Sector (5%)

Local Public Libraries (systems) (2%) / Media (5%)
Education Affinity Groups: Associations. Organizations (2%)
State Government Agencies and Commissions (5%)

Anonymous (4%)

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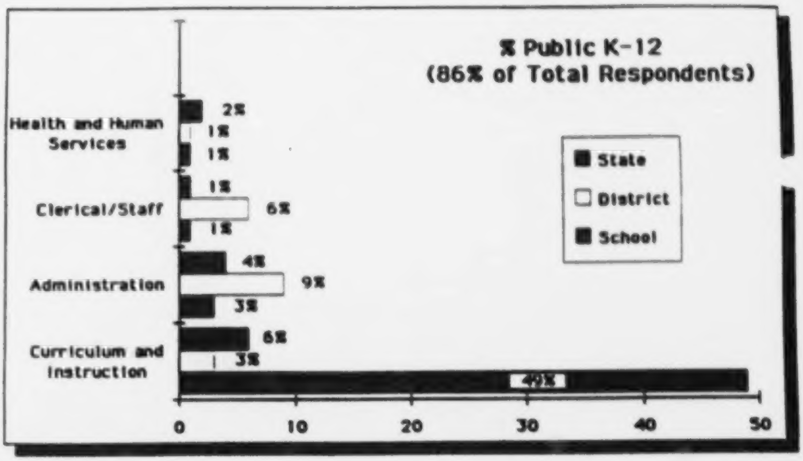
* Greater than 100% due to multiple-role respondents

Graph A


% Public K-12
(86% of Total Respondents)
Health and Human Services
Clerical/Staff
Administration
Curriculum and Instruction
State
District
School
2%
1%
1%
1%
6%
1%
4%
9%
3%
6%
3%
49%
0
10
20
30
40
50

Survey Item #1:

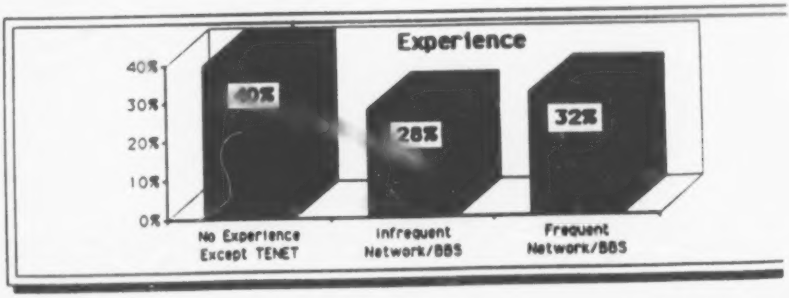
What best describes your experience with computer networks?

40%	A	No experience except TENET
28%	B	Infrequent user of another network or bulletin board
32%	C	Frequent user of another network or bulletin board

These results suggest the need for a substantial TENET training program in order to maximize TENET's usefulness. Since the survey respondents are a proportionally more sophisticated group of TENET users, that means that an even greater percentage of the entire user pool of 15,000 requires extensive training. From previous experience, we know that initial training, delivered while the curiosity and attraction is high, is the most effective to bind the trainee to the activity, while more in-depth training is necessary to ensure that the user moves beyond the more straightforward uses of the network such as e-mail and begins to use the full capacity of the network to support instructional practices. The results from Item 8, where training is cited as the fifth most important limitation to TENET use, seem to bear out the idea that a more random group of users would show an even greater and immediate need for training intervention.

Possible further study: A comparison of "A" and "C" responses to other survey items would yield data regarding the effect of prior experience on TENET use and value.

Chart 1



Survey Item #2:

Which features of TENET have been most useful to you? (please rank your selections: 1,2,3,etc.)

1st	A	Private electronic mail
3rd	B	Group discussions or conferences
4th	C	Public announcements or bulletin board notices
2nd	D	INTERNET resources
5th	E	Electronic database searches
	F	Other

The margin of "A" over "D" was more than 2:1, with "B" "C" and "E" tightly grouped. Part of the reason for lack of discrimination between items appears to be that many respondents ranked 1-3, misunderstanding the "etc." directions to rank 1-6. As a result, responses were weighted as if the unmarked responses were the least useful. Despite some items being ranked toward the bottom, all selections received substantial second-place votes. Nearly all "other" responses could fit in A-E. Seven "other" responses were unique, and all dealt with being able to learn about new procedures or systems available to users as a result of being on TENET, e.g., Unix.

Comparison of Item 2 and Item 8 responses suggests a more aggressive effort to expand user communication patterns. This might include a special effort to recruit persons or organizations to be online with conversations/e-mail on issues of the greatest appeal for those already on the network. The anecdotal data clearly suggest that users are talking in role-alike, horizontal groupings, so there is an apparent need to begin intervention programs to get more cross-role and vertical communications. TENET, because of active efforts to recruit a diverse user pool, particularly where affinity groups are concerned, is in a unique position to enhance efforts in site-based decisionmaking and integrated curriculum efforts which require these kind of new communication patterns.

Possible further study: Explore within category preferences with additional inquiries to respondents and by categorizing the anecdotal responses to create a management information document which could be used to guide the development and evolution of existing and additional system features. For instance, many respondents had specific suggestions for conferences or making affinity group participation on the network more useful.

Chart 2

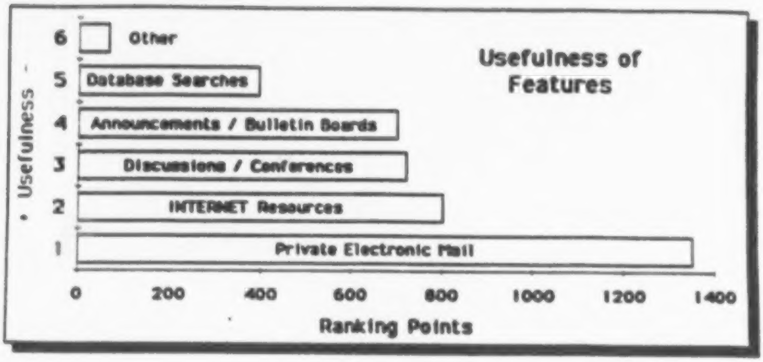
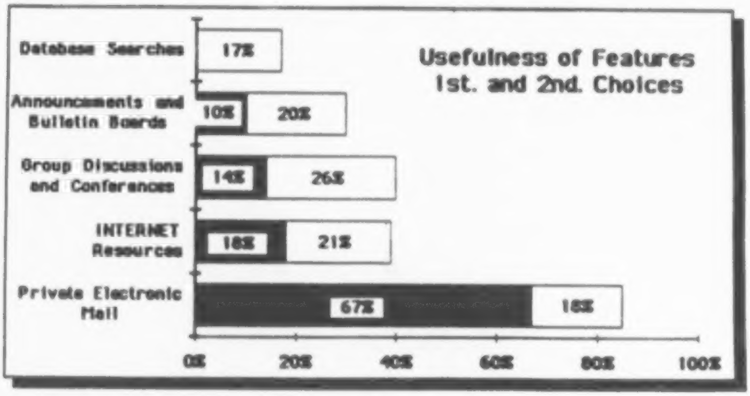


Chart 2A



Survey Item #3:

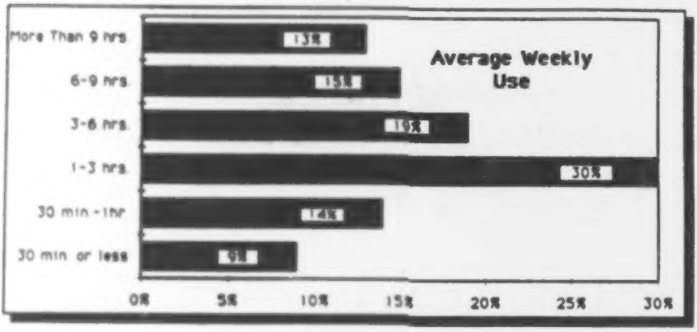
How much time in an average week do you use TENET?

9%	A	30 minutes or less
14%	B	30 minutes to 1 hour
30%	C	1 - 3 hours
19%	D	3 - 6 hours
15%	E	6 - 9 hours
13%	F	more than 9 hours

This was a more even distribution than expected, based on the assumption that the sample was a self-selected sample of high-end users. Item #3 responses, coupled with the responses from Item #4, sends a clear message that system transport and connectivity components will be severely taxed in the near future with the meteoric rise in network enrollments.

Possible further study: Explore whether high-use respondents are also multiple-feature users.

Chart 3



Survey Item #4:

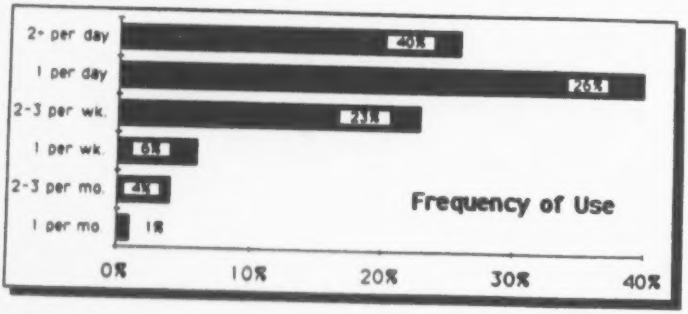
How often do you sign on TENET?

1%	A	once a month or less
4%	B	2 - 3 times per month
6%	C	once per week
23%	D	2 - 3 times per week
40%	E	daily
26%	F	several times per day

It is difficult to understand why there is such a large proportion of daily users and those who reported multiple sign on per day for an admittedly inexperienced user pool If this really is a representative sample, then it's little wonder that TENET is quickly becoming jammed with traffic, and it would speak to the immediate need to create a managed-access plan for users and their traffic demands

Possible further study: Explore the reasons for the large jump to multiple uses per week If it is a function of a learning curve, then large shifts can be expected as the user group becomes more skilled

Chart 4



Survey Item #4A:

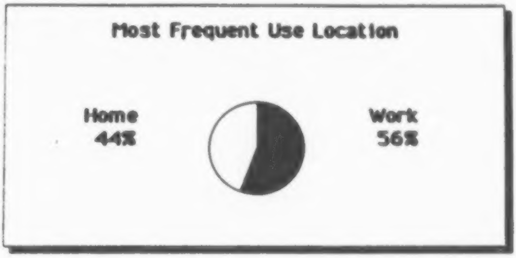
Are most of your sign-ons from your work or home?

56% Home
44% Work

Although the widely-held belief is that schools lack the necessary connectivity to allow teachers to be online from the workplace, this relatively equal response seems to indicate that many more teachers have workplace access than is thought. However, since the survey sample represents high-end users, the result cannot be generalized to all educators in the state. The result is also clouded by the number of respondents who reported nearly-equal use from both access points, a trend which can be expected to grow with the continuing spread of electronic telecommunications in domiciles and which will result in even-greater demand for TENET access at hours which are not now considered prime time. There was strong anecdotal evidence to suggest that access from home does not necessarily occur primarily because access at work is unavailable, but, rather, that it is a preferred access point because of the school day's schedule demands. There was, however, a substantial body of anecdotal data clearly supporting the premise that workplace access is a major problem for many users, administrative as well as instructional.

Possible further study: Explore any differences in the kinds of network activities engaged from each access location.

Chart 4A



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Survey Item #5:

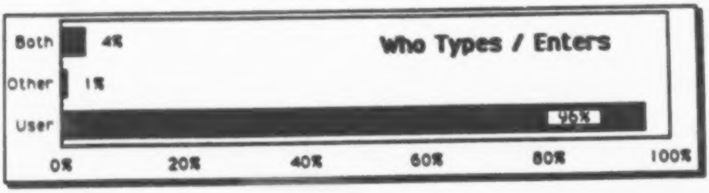
Do you type/enter commands/data yourself?

96% A Yes. I type/enter myself
1% B No. I have someone else type/enter
4% C Both A and B

One might assume that a "B" response meant it was by administrators or managers, and that secretaries or administrative assistants were the "someone else". However, nearly all administrators and managers reported performing their TENET online activities themselves. Only in three cases did administrators or managers report otherwise, and those were specifically directed to duties which involved clearing posted notices for information and distribution or posting routine communications. This does not, however, preclude the large number of anecdotal responses from instructional and administrative personnel who decried the fact that their administrators and managers were not TENET users. It would seem that administrators and managers find TENET equally as viable for their work as do instructional personnel once they are introduced to the system, supporting the premise of "Traditions As Barriers" in Section 1 of this report. Those answering "C" were exclusively teachers who cited students as the "B" in their response. There were no reported disabled users who were unable to type/enter data.

Possible further study: Compare use patterns and feature preferences between administrative, instructional personnel and students.

Chart 5



Survey Item #6:

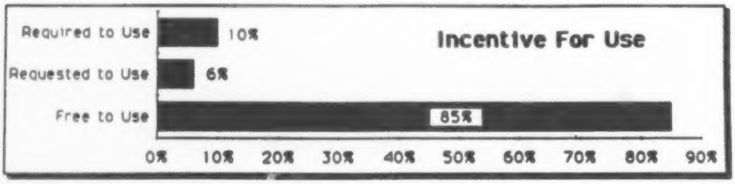
Which statement best describes your use of TENET?

10%	A	I am required to use TENET
6%	B	I am requested to use TENET
85%	C	I am free to use TENET as I wish

This item was designed as an extension of Item #5, searching for expected differences in users based on work roles. It did not yield any new insights. Administrative, staff and clerical users who answered "A" or "B" made it quite clear that they would be on TENET even if it were not a required part of their work role. The anecdotal data strongly indicates that the administrators who are online are actively and personally involved as network participants.

Possible further study. This item does not seem to generate data for continued collection or investigation.

Chart 6



Survey Item #7:

Which statement best describes your judgment of the worth of TENET?

1%	A	It is useless
1%	B	It is useful for others, but it is not useful for me
2%	C	I am skeptical about it's usefulness for me, but I'm willing to keep trying
1%	D	I am basically indifferent or neutral
13%	E	It has some limited use for me. For example
58%	F	It is useful for me in many respects. For example
32%	G	It has revolutionized my work/communications processes. Please explain

Respondents who selected "A" or "B" were adamant about clarifying their responses to be sure it was understood that the responses had nothing to do with TENET, but, rather, were entirely a function of connectivity or logistics, i.e., too many users sharing the same phone line or an inaccessible computer location.

All respondents selecting "C" described themselves as novice users who were overwhelmed.

Respondents selecting "D" reported disillusionment or frustration with their TENET experience.

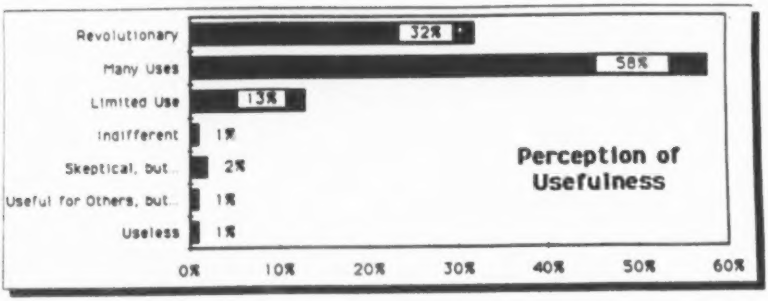
Respondents seemed to have some difficulty discriminating between choices "E" and "F". Since the content of the anecdotal responses accompanying these two selections did not differ at all, it appears the extent to which respondents felt they were accomplished or experienced users determined their choice. In both cases respondents cited specific uses or features that were important to them, and in each case they were enthusiastic about the importance of the uses and features. The number of examples given did not differ significantly between "E" and "F" and in each case the examples described the extent to which users explored the system.

Respondents also seemed to have difficulty discriminating between "F" and "G" since over half of the respondents selected both. The examples provided in response to "F" offered more detailed lists or concrete examples of uses/features, and responses to "G" provided more comments and personal expressions, often about the same lists or examples in their "G" responses.

Of particular interest here is the choice of the word "revolutionized" for the item. Only a few respondents suggested anecdotally that the word overstated the case so much that it discouraged their response beyond the "F" that they chose. In each case, however, they then continued their remarks by citing examples of ways in which they felt TENET had changed their environment in a stronger fashion than they felt an "F" response would indicate. In nearly all cases where "G" was selected, respondents wrote extended comments, the tone and words of which clearly agreed with what would normally be associated with the word "revolutionized."

Possible further study: Analyze and categorize the substantial number of anecdotal responses to "F" and "G" and determine their usefulness for a management information document or inclusion in TENET training and information materials.

Chart 7


Revolutionary
32%
Many Uses
58%
Limited Use
13%
Indifferent
1%
Skeptical, but...
2%
Useful for Others, but...
1%
Useless
1%
Perception of Usefulness
0%
10%
20%
30%
40%
50%
60%

Survey Item #8:

What limits your use of TENET? (Please rank your selections: 1,2,3,etc.)

6th	A	Inconvenient computer location
8th	B	Preference for face-to-face or telephone communication
4th	C	Not enough phone lines
2nd	D	People with whom I wish to communicate are not available or accessible through TENET
3rd	E	TENET is busy
1st	F	Not enough time
7th	G	TENET is too cumbersome or difficult
9th	H	Preference for longhand or dictation
5th	I	Lack of training

The first and second choices of respondents are items which deal most strongly with the human element and meeting the individual needs for integrating TENET into work and lifestyle, making TENET an embedded part of the way in which users conduct their daily personal and professional business. This may have implications for scheduling and work pattern changes which could enhance the opportunities for users to fully integrate the system into their activities. Many respondents offered comments about how TENET allowed them to maximize their time and use it more effectively, so the strong response to "F" may indicate that TENET offers them so much that there isn't time to explore all the options (not unlike the stack of magazines or newsletters which doesn't get read). It seems to be a plea for more time to figure out and use what TENET has made available.

The third and fourth place responses confirm the anecdotal data gathered throughout the survey and in the focus groups in which respondents repeatedly cited connectivity and access as major problems. From most respondents' comments, it appears that the selections did discriminate between the two factors, and that the "C" response refers exclusively to phone lines at the users' points of access.

The sixth ranking response deals with a different kind of access and reflects a large number of comments from users about the location of what was often the one and only computer in a school building. There may be considerations here for building shared-use recommendations for sites to maximize equipment availability or of emphasizing portability in future equipment acquisitions.

The fact that responses ranking fifth and seventh deal with access and training stands in sharp contrast to the anecdotal data in every section of the study and the focus groups where requests for greater access and the need for training are punctuated with myriad war stories. One interpretation is to say that no matter how important these elements may be, the appeal of the system is so strong that respondents will muddle through on their own to learn the system and its features.

Possible further study: Explore with "D" responders who they would like to be able to access on TENET. The comments were substantial about programs or services which were on the "wish lists" of users, but there were few references to individuals or groups.

Chart 8

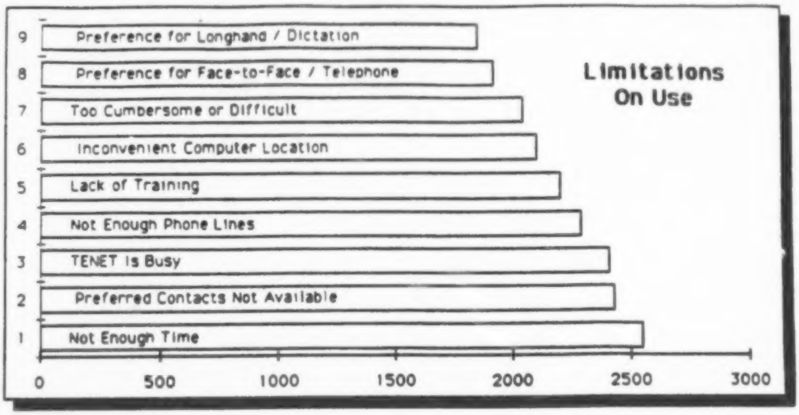
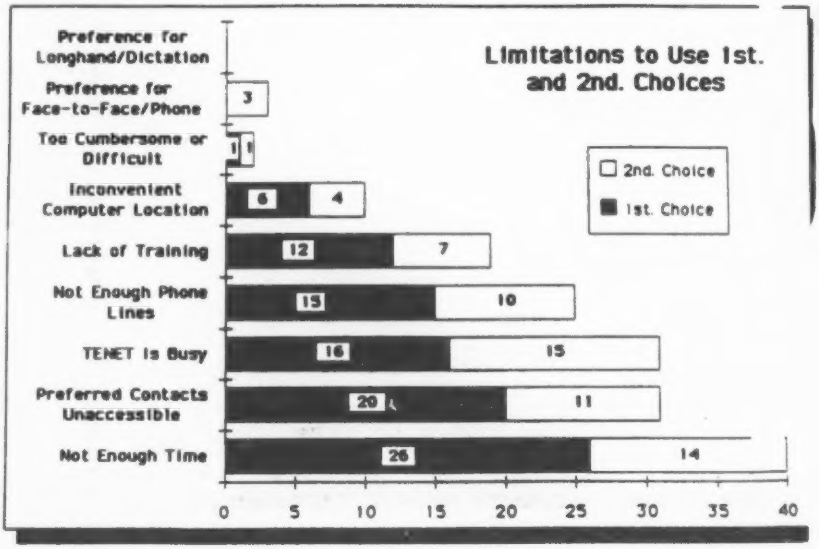


Chart 8A



Survey Item #9:

What would make TENET more useful for you?

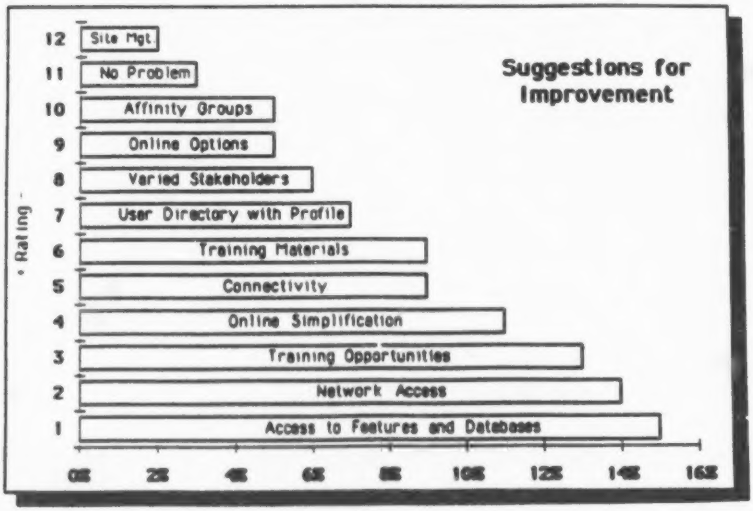
The total number of respondents making suggestions for improvement was 148. There was substantial interest in enlarging the range of options available to TENET users and by expanding those already available, e.g., expanded library privileges, access to more library resources, unrestricted access to Internet. Of nearly equal importance was the question of getting access to the network host.

The second most common group of comments were training-related, including increased training and simplified online procedures which would require less sophisticated training in order to navigate the system. These requests, coupled with connectivity questions such as being able to get phone lines and hardware, are from users who appear to be struggling with their TENET use.

The third most common collection of responses dealt with which stakeholders are online and the quality of interaction with them. Included here is the desire of users to have TENET availability for anyone with whom they might want to converse. A handful of respondents suggested improvements which are actually presently available on TENET, but which their level of experience had not allowed them to know the availability of the options.

Possible further study: Compile a management document by further categorizing responses. It might also be appropriate to submit such a list to users, measuring their importance as changes or additions for TENET management to consider by role group.

Chart 9



Survey Item #10:

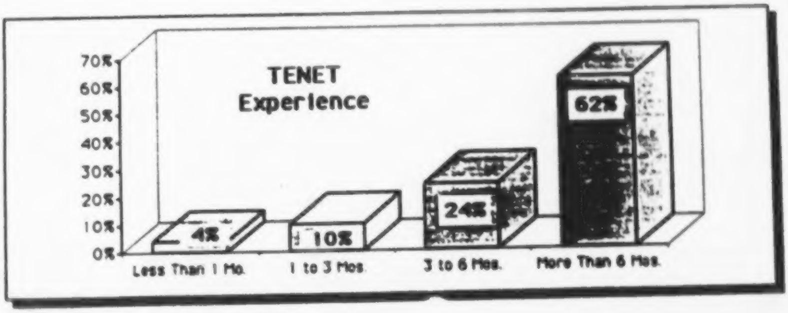
How long have you been using TENET?

4% A less than 1 month
10% B 1 to 3 months
24% C 3 to 6 months
63% D more than 6 months

With the network availability beginning in the 1991-92 school year, the data support how quickly large numbers of people began using the communications network. There was virtually no difference in results between the first wave of responses to the survey and the second wave, despite the fact that they were separated by four months. About 14% are relatively new users (less than three months experience) at any point in the year and about 87% appear to be finding the network useful enough to continue accessing its offerings.

Possible further study: Explore the responses to Item #8 and #2 relative to the respondents' TENET experience.

Chart 10



Survey Item #11:

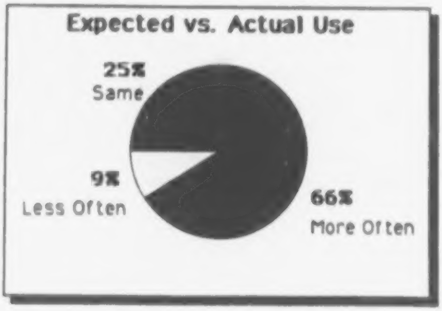
How often do you use TENET now compared to what you expected when you signed up for the network?

66%	A	more often
9%	B	less often
24%	C	about the same

The responses to "A" appear to be driven by the relative ignorance of potential users regarding the possibilities for use available to them on TENET. The anecdotal data supplied in response to other items is clear about how startled new users are with the amount of information and extent of options for them. There is no way for them to know the number of hours they might end up spending exploring INTERNET resources, for example. Inquiries were sent online to all "B" respondents who identified themselves. All replied to the inquiry citing logistics, connectivity or extenuating personal circumstance as the reason for the response. None of the respondents indicated that their reduced use was a function of disinterest or disenchantment with TENET.

Possible further study: Explore the rationale of "C" respondents. This potentially could be the group of users who might eventually drop off the system. They might, however, just be a portion of the 32% of the users who indicated that they were frequent users of other networks and bulletin board systems and, therefore, not naive or ignorant of the use and time quotients which they would bring to TENET participation.

Chart 11



TENET IN THE LARGER CONTEXT

Deneen Frazier, M.Ed.
AtWork Networks

National Context

Over the past decade, there has been a tremendous surge in the growth of technologies which make electronic communication more affordable, accessible and worthwhile. With these technological advances--increases in modem and processor speeds, seamless software programs, and more interconnection between networks--the public now has direct access to a new world of communication which traditionally has been inhabited only by higher education and research sectors.

Middle class America is now the targeted market for public networks and services. By subscribing to public networks like Prodigy, CompuServe and AT&T Mail, consumers can make their everyday lives easier. For example, with CompuServe, you are able to make flight reservations using the OAG Guide, complete banking transactions, and check a stock's status on the Dow Jones, all from your home computer. In essence, the technology is so accessible that it is making everyone think about how to live their lives differently.

While this increase in growth and interest was occurring on the consumer front, the education sector has been in a "watch & observe" mode. Historically, educators have always been reluctant to adopt new technologies primarily due to a great lack of budgetary and time resources. In fact, it is a rather recent development that educators have embraced the computer as an effective tool to advance student learning. Unfortunately, most teachers have received only limited training on how to utilize the capabilities of the computer to enhance instruction. The thought of adding telephone lines to these computers has often overburdened those educators who actually get excited about technology and learning.

While this picture may seem overwhelming, there does appear to be a promising future. In the fall of 1992, Vice President-elect Gore sponsored the passage of S.272, a bill known as the National High Performance Computer Program. This legislation will allocate $2.9 billion over five years across a number of governmental agencies to connect the nations' colleges, universities, and libraries to NREN, the National Research and Education Network. This is an existing network that will now begin to involve the K-12 educational sector and move toward the goal of building a "national superhighway." With this increase in national attention and funding, educators all around the country will be able to incorporate telecommunications more into everyday school life.

State Context

The experiences with technology and approaches to creating a statewide network vary dramatically for every state. However, based on several surveys conducted within the past several years (McAnge, 1990 & Kurshan, 1990), it is clear that every state is moving toward or currently does support some type of network structure. These networks include instructional television, satellite, and telecomputing networks, the last of which is describes TENET.

Until about five years ago, most of the telecomputing networks were supporting only administrative tasks. With the advent of user-friendly spreadsheet and database applications, state-level administrators realized that the transfer of the local budget and administrative information could be handled electronically. For example, student records could be transferred electronically to all schools and Superintendents' budgets could be sent electronically to the state controller. While both of these electronic transfers reduced the amount of time and paperwork necessary to complete the clerical task, the power of the network is only just being realized by the principals, secretaries and counselors.

As the administrative use of telecomputing advanced, classroom teachers began to explore how student learning experiences could be enhanced through the powerful tool of electronic communication. Utilizing telecommunications for instructional purposes has been viewed as an "add on" feature to some statewide networks with very little outreach to the classroom teachers. Even today, school districts have benefited from only minimal exploration by an ad hoc collection of isolated educators rather than taking a systemic approach to the use of technologies for multiple purposes and stakeholders.

As is shown by the two surveys mentioned above, 33 states currently support an existing network at some level. Thirteen states had proposed networks at the end of 1991. Within a number of states, there are a variety of programs which may involve only one school site or district. These would include National Geographic's Kidsnet which links individual classes around the country or Hawaii's Global Teleclass which links Hawaii's students with students internationally to develop language skills. Within the 33 existing statewide networks, there are a core nine states which are recognized nationally as the leaders in the field. These states are Arizona, Florida, Nebraska, Indiana, New Mexico, Pennsylvania, Texas, Virginia, and West Virginia. These are the states that other states entering into planning and pilot phases of their own networks will use as models for their own growth and development.

Comparable State Efforts

For the purposes of the TENET evaluation, four of the remaining eight states were chosen from the core group as benchmark networks which would serve as strong bases of comparison. These states and their respective networks are:

- Florida (FIRN)
- Pennsylvania (PENN*LINK)
- Virginia (VA-PEN)
- West Virginia (WVMEN)

These networks were chosen as the benchmarks by which to measure TENET's strengths and weaknesses due to their similarities in scale or size and intended reach. All these networks service their entire respective states, are utilized by educators and are at least partially subsidized by the state government. Given these broad similarities, these networks are unique in that they were started to serve different functions and different populations by using different training and technical assistance models. Table 2 and Table 3 highlight major services and features of statewide telecomputing networks with a comparison TENET and the other networks. Table 2 summarizes the major similarities and differences while Table 3 provides the detailed information from which the summary has been drawn.

Table 2

SUMMARY OF MAJOR SIMILARITIES AND DIFFERENCES BETWEEN TENET AND FOUR STATE TELECOMPUTING NETWORKS

MAJOR SIMILARITIES	COMMENTS
Internet Gateway	Only one network has yet to add the Internet as a service. This is a key component which should be upgraded in any way possible (e.g., advanced search programs, etc.)
Staffing	TENET currently supports about the same size staff as three other networks but services approximately twice the number of users
Software	Although TENET operates a variety of software (PINE, USENET, CAUCUS) which is different from a prevalent popular choice of DEC's "All In One," the goal is the same: to provide users with the ability to navigate through electronic mail, bulletin boards and conferences

MAJOR DIFFERENCES	COMMENTS
Budget Amount	TENET's current annual budget ($1,247,000 in 1992) demonstrates a high level of state commitment. The only state which has made a more substantial commitment is Florida, with a budget eight times that of TENET to support a multi-use network serving half as many users
Outreach Activities	Only TENET and FIRN have developed formal activities designed to obtain new users
Training Delivery	TENET is the only network which uses trainers from multiple stakeholder groups
Number of Users	TENET is approximately double the size of any other existing statewide network
Intended Audience	TENET has attracted users from multiple stake-holder groups (VA and WV make it available but do not encourage it with the outreach activities)
Cost to User	TENET charges a minimal fee of $5.00
Intended Purpose	TENET is the only network which places equal importance on instructional and administrative use of the network
Authorizing Entity	TENET is the only network which has been legislated into action

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TABLE 2: COMPARISON OF TENET TO FOUR STATEWIDE TELECOMPUTING NETWORKS

NETWORK FEATURES	TENET (Texas)	PENN*LINK (Pennsylvania)	FIRN (Florida)	VA-PEN (Virginia)	WVMEN (West Virginia)
AUTHORIZING ENTITY	State Legislature	Dept. of Education (in partnership with Penn State University's Department of Agriculture Extension Service)	Department of Education	Department of Education	Department of Education
INTENDED PURPOSE	Instruction & Administration	Administration	Instruction & Administration	Administration	Training & Instruction
INTENDED AUDIENCE	Administrators, Teachers, Students Any community member demonstrating an interest in education	Superintendents They can also maintain additional accounts for teachers and librarians	Teachers, Administrators Higher Education - new audience includes only a few professors & students	Administrators, Teachers, Students Any community member demonstrating an interest in education	All West Virginia residents (particularly teachers, students, parents, business)
SERVICES	Online Messaging Conferencing Internet Gateway File Transfer Database Access CNN Classroom Cleveland FreeNet Gateway Reference Tools List Serves	Online Messaging Bulletin Boards Internet Gateway File Transfer Database Access CNN Newsroom Satellite Learning Program Schedule Legal Case Summaries Accessible by other government agencies	Online messaging Bulletin Boards Internet Gateway File Transfer Interfaces with other networks Database Access Newsweek Education Program CNN Newsroom	Online Messaging Conferencing Internet Gateway (most servers) File Transfer Interfaces with other networks Newsgroups	Online Messaging Conferencing Bulletin Boards Courses (college-level)
DESIGN OF TRANSPORT SYSTEM	Planning Phase: First Planning Mtg. - Fall 1988 Network Online - Aug. 1991 Hardware: Utilizing existing inter-university network, local UNIX hosts Local and 800* access is supported Software: PINE Mail System USENET News & Conferencing	Planning Phase: First Planning Mtg. - 1981 Pilot Phase - 1981-1984 Network Online - Nov., 1986 Hardware: Utilizing existing nodes all across the state 2/3 of state use local call access Software: All-in-One (DEC)	Planning Phase: First Planning Mtg. - 1977 Network Online - 1982/1983 Hardware: Utilizing existing hardlines of universities, community colleges, local school networks Software: All-in-One (DEC)	Planning Phase: First Planning Mtg. - May, 1989 Network online - Fall, 1990 Hardware: 40 servers across the state Use existing inter-university network Software: USENET News & Conferencing	Planning Phase: First Planning Mtg. - 1981 Network online - 1983 Hardware: LAN's (Novell) connected to six nodes Accessible by 4 toll-free and 2 local lines Software: RBBS (Remote Bulletin Board System)

NETWORK FEATURES	TENET (Texas)	PENN*LINK (Pennsylvania)	FIRN (Florida)	VA-PEN (Virginia)	WVNET (West Virginia)
USER REQUIREMENTS USER COSTS	All user platforms are supported. Cost to user: $5 per year $25 per year for independent schools and post-secondary accounts	All user platforms are supported. Cost to user: $25 one-time set-up fee ($225 for those outside the school system) $11/hour $315 - Average annual usage charge	All user platforms are supported. Cost to user: None	All user platforms are supported Cost to user: None	All user platforms are supported. Cost to user: None
DELIVERY OF TRAINING	Train the trainer" model: Master trainers (50) were identified at Regional Service Centers, State Department of Education, and educational organizations to train others at the local and state levels.	Network Field Coordinators (29 total) are employees of Pennsylvania's Intermediate Units	2 FIRNSOL's (Support for Online Learning) 10 FIRNTEC's (Technical Education Consultant) Coordinate group and one-on-one training Summer Training Workshops providing certification credit	Local inservices coordinated by certified trainers.	"Train the trainers" model Spent first few years of network implementation holding many workshops all around the state. In its tenth year most local sites have a trainer available or receive training from other affinity groups.
USER ENROLLMENTS (as of 11/92)	Approx. 15,000 users	Approx. 800 users Only 4 LEA's do not have accounts 90% of all accounts are used each week	Approx. 5,000 users 50 new accounts processed per day	6,000 users	7,000 users (as of 11/92)
STAFFING	2 Full-time (paid by Dept. of Education) 1 Full-time and 3 part-time to answer support line (paid by University of Texas)	3 Full-time (paid by Dept. of Education) All invoicing is done by Penn State Univ	2 Full-time Clerical 1 Full-time to answer 800* Help Desk 1 Student (1/2 day)	11 Nodes supported by 2 volunteers (technical administrator and instructional facilitator)	5 Full-time
TECHNICAL SUPPORT	Regional education service centers and district level trainers work in tandem to provide support. Online help message box Direct help line (mail, normal business hours)	Field trainers are given workshops two times a year with updated materials 3-tiered support structure: 1. Field trainer 2. Online "Professor" 3. Direct call to Dept. of Education	2 FIRNSOL's 10 FIRNTEC's 800* Voice Help Line	Each node supports its own group of users.	8 technicians hired by DOE to cover 8 regional areas of state

NETWORK FEATURES	TENET (Texas)	PENN*LINK (Pennsylvania)	FIRN (Florida)	VA-PEN (Virginia)	WVNET (West Virginia)
FUNDING SOURCE(S) BUDGET AMOUNTS	Fully supported by Dept. of Education 1991 - $1.17 million 1992 - $1.25 million	Subsidized by the state at 60% $70,000 per year for network subsidy (does not include 3 full-time staff)	Fully supported by Dept. of Education 1987-1990 - $8,606,284 (each year) 1990-1991 - $7,286,851 1991-1992 - $5,633,042	Fully supported by Dept. of Education 1992 - actual figures not available	3 Different Funding Sources 1992 - $150,000
OUTREACH STRATEGIES	Affinity groups Trainer coordinated workshops Videoconferences	Demonstrated to audiences the reduction of cost with use of e-mail	Yellow Pages - hard copy directory of users Ed. Tech. News - bimonthly newsletter Instructional Resource Guide Flyers of new programs	One teleconference Two symposia Word of mouth	Word of mouth
FUTURE PLANS	Continue to decentralize the network by expanding the reach of the network to the nodes at actual local schools	Teacher Pages - Read only bulletin board Pennsylvania is moving toward outcome-based education which may push the network to include an instructional focus	CD-ROM Project - for Hospital/Homebound students FASTER system - transfer of student records Conferencing	In early 1993, network operations will be centralized in Richmond. Additionally, the infrastructure of the network will be broadened to include instructional capabilities, called the "Academical Village"	Internet Gateway Investigating the use of a packet-switching network

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McAnge, T. R. (1990). A survey of educational computer networks. Blacksburg, VA: Virginia Polytechnic Institute and State University.

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Conclusions

If TENET is to maintain its role as a leader in statewide telecomputing and, as a result, in making revolutionary changes in instructional collaboration and student learning, the network's weaknesses must be recognized and appropriate changes made. The following is a list, in priority order, of the conclusions reached as a result of this study.

Maintain close relationship with NREN developments

With the involvement of TENET's director with the Consortium for School Networking (CoSN), the experiences of TENET are playing a significant role in the development of the "national superhighway." Since TENET is the network which most clearly is dedicated to supporting teachers and students, it is critical to continue voicing this approach as the NREN develops and grows.

Monitor hardware and software capacities

With the rapid increase in numbers of users, the capacity levels of current hardware and software must be monitored and upgraded early in advance of educator demand. Otherwise, it is predictable that users will turn away or become disillusioned quickly once they are not able to dial in due to an overload on the incoming lines. Due to the distributed structure of TENET, users will be best served by the development of software which simulates the work done by network software like "All In One" on the user's desktop computer. This will provide a more "user friendly" and beneficial environment.

Provide both links between local area and wide area networks

Research the linking of local area networks to wide area networks. The network cannot scale up as an individual computer, modem and phone line situation. TENET has helped illustrate the need for local communication as well as wide area communication.

Monitor levels of technical support & training

Ensure that levels of support and training remain consistent as the number of users continues to increase at dramatic rates. TENET is by far the largest educational state network, but size, in and of itself, will not automatically continue the benchmark status it currently enjoys. During the first year of operation, training and support concentrated on orienting the user to the system. In the coming years however, users' needs will command training at a number of complex levels which will include not only orientation but also Internet gatewaying for example.

Provide new opportunities for discussion between multiple stakeholders

One of the significant and exciting differences between TENET and any other state network is the focus on collaboration among multiple stakeholder groups. Currently, TENET's trainers represent a variety of educational roles and education-related organizations. Unfortunately, the current interaction is focused on accessing information, especially the information of the affinity groups. Over time, it will be more important to increase the level of dialogue and the sharing of information which TENET could foster with the development of new strategies.

Increase current staff size

TENET is currently operating with 2 full time staff people (including the director) to service 15,000 users. While this staff size is commensurate with the other comparable statewide networks, TENET supports almost double the number of users on those same networks.

Create a governance model

The size of TENET, its rapid growth, exponential changes in technology, the decentralized structure of the development and operations of the network, the multiple stakeholder trainer model and the number of agencies, organizations and institutions using the system, suggest that a flexible, quick response governance system needs to be established. To do this, the director of the network needs to have a closer working relationship with the developer and operational contractors. The governance model needs to foster an interactive collaborative relationship between network management and governance structures which include active participation by all network stakeholders.

NEWS

CONSORTIUM FOR SCHOOL NETWORKING

Vol. 1, No. 1 [illegible]

About CoSN

The Consortium for School Networking (CoSN) is a membership organization of institutions formed to further the development and use of computer network technology in K-12 education. Members represent educational, institutional, and commercial organizations with an interest in advancing the state of the art in all aspects of electronic computer networking. For more information contact CoSN: P.O. Box 65193, Washington, DC 20035-5193, 202/466-6296, cosn@bitnic.bitnet.

Join CoSNDISC

CoSN hosts a mailing list which provides a forum for discussion of issues relating to the development of networking facilities for the K-12 community. To join COSNDISC send an e-mail message to: LISTSERV@bitnic.bitnet. Include the following information in the body of the message: Subscribe COSNDISC, your first and last name.

Major Hardware Donation From DEC

Digital Equipment Corporation has approved a donation of over $50,000 in hardware, software and services to CoSN. The equipment includes two DEC 5000 workstations with extra memory and large disk drives; two laptop and one PC-level machine. In addition, the donation provides for software and for maintenance support.

The equipment enables CoSN to provide two key services to the K-12 community. One of the workstations will be installed at SURAnet, where it will be connected to the network and will serve as CoSN's "presence on the net". The other machines will be used for traveling demonstrations of Internet access for educational pupposes.

Thank you DEC for your commitment and suppon of CoSN and K-12 computer networking!

CoSN Server

A portion of the equipment donation from DEC is being set up at SURAnet in College Park, Maryland. This equipment will form part of a new Internet domain, cosn.org, and will provide services to CoSN members and the educational community at large. Members are invited to join the Technical Committee and help set up and maintain these services. The new facility should be operational by the end of the month.

CoSN Now In Gopher Space

Thanks to the donations of equipment and time from IBM, EDUCOM, and CoSN member Marco Hernandez, CoSN now has its own Gopher server! Gopher is a tool that allows easy access to text files, databases and other searchable resources. The gopher address is: cosn.educom.edu. Come visit!

Networking For Education in the Capital

Bills to move the National Research and Education Network (NREN) forward are in process. In the Senate, S.4 is the relevant bill; Title VI deals with information infrastructure and technology, calling for networks to improve education, to provide library services, and to support health care and manufacturing. A similar bill is being developed for introduction in the House.

H.R.89 was introduced in the House; it would set up a program of technology grants to the states and would establish an Office of Technology reporting directly to the Secretary of Education. A bill with similar intent (but a lot of other provisions, as well) is in the works in the Senate.

– John Clement

Conferences, Committees & Presentations

The following is a list of recent CoSN presentations:

Library of Congress' Network Advisory Committee (Dec)

Coalition for Networked Information, Teaching and Learning Group (Jan)

American Association for the Advancement of Science, Technology Coordinators for the pilot projects in Project 2061, the Science Curriculum Initiative (Jan)

Florida Education Technology Conference (FETC)(Feb)

American Association of School Administrators (AASA) (Feb)

Michigan Association for Computer Using Learning (MACUL)(Feb)

National Forum on Educational Statistics, Automated Information Retrieval Systems (AIRS) working group (Feb)

Computer Systems Policy Project (Mar)

American Society for Information Sciences (ASIS) midwinter regional meeting, Potomac Chapter (Mar)

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CoSN Committees

Members are encouraged to join the following recently formed committees. (Note that e-mail address of chairs' are in brackets).

Policy– Focuses on the legislative issues which must be addressed to ensure the development of a network which adequately serves the needs of the nation's schools [cstout@tenet.edu, NY0026@mail.nyser.net]

Technical–Addressing the technical issues which must be solved as the network is put in place [rdc@vms.cis.pitt.edu]

Curriculum–Seeks to catalog current telecommunication projects and develops standards of excellence for future projects [gsolomon@nycenet.edu]

Professional Development–Addresses techniques and practice of online instruction [franko@bigsky.dillon.mt.us]

Vendor Liaison Group–Facilitates the interaction of business members of the Consortium with participating departments of education, school districts and teachers. [Contact jfenwick@attmail.com for more information]

Membership Committee–CoSN is beginning a major membership campaign. To join, contact Bobbi Kurshan at [kurshan@vtvm1.bitnet]

You don't need to be a member of this committee to contribute. If you know of groups CoSN should contact, please forward their names, affiliations, phone numbers, land and e-mail addresses to Ellen McHugh [mchugh@bitnic.bitnet] or call 202/466-6296. Also share information about CoSN and K-12 networking with your colleagues. If you need brochures or additional newsletters, contact Ellen.

Upcoming Conferences

April 14-16, 1993 - National Net '93: "Extending the Benefits", Washington, DC. Clement, Stout and Carlitz will present a session on K-12 networks during a morning session on 4/16.

April 16-20, 1993 - AERA symposium: "The Educational Implications of Electronic Networks", Atlanta, GA. A discussion led by John Clement will include members of the US Department of Education, ERIC Clearinghouse on Information Resources, Arizona State, Far West Laboratory and CoSN.

April 27-28, 1993 - The National Infrastructure Conference hosted by TeleStrategies, Reston, VA. Panel sessions include "The Role of the NSFNet and NREN", and "Grassroots Infrastructure Testbeds". Two CoSN Board members will be panelists.

June 27-30,1993 - National Education Computing Conference, Orlando, FL.

November 10-13, 1993 - CoSN full membership meeting held in conjunction with the Second International Symposium on Telecommunications in Education and Tel-Ed '93, Dallas, TX.

Inside CoSN

Board Chair, Connie Stout, was named to the National Research Council panel conducting a mid-course study of the National Research and Education Network (NREN).

Executive Director, John Clement, has been spending one-half of his time with National Science Foundation's Education and Human Resources Directorate program officers on access and use of the Internet for professional development and educational support.

CoSN Summary

Wonderfully varied new Internet resources have been posted on CoSNDISC. The following are some highlights from recent months:

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WE ENCOURAGE READERS' CONTRIBUTIONS AND SUGGESTIONS TO THE CoSN NEWSLETTER!

• § •

CONSORTIUM FOR SCHOOL NETWORKING
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International Society for Technology in Education
1787 Agate Street, Eugene, Oregon 97403-1923 Phone: 503/346-4414
Fax: 503/346-5890 CompuServe: 70014,2117 Internet: ISTE@oregon.uoregon.edu

The International Society for Technology in Education (ISTE) is a nonprofit membership organization for technology-using educators. Its mission is to promote appropriate uses of technology to support and improve teaching and learning.

ISTE, one of the largest professional organizations of its kind, has 40 geographic and regional affiliates throughout the United States, Canada, and other countries. The society provides a wide range of products and services in support of educational technology professionals.

ISTE's ideals and foundation were established more than 20 years ago. The organization was created by the 1989 merger of the International Council for Computers in Education (ICCE) and the International Association for Computing in Education (IACE). ISTE was created to provide leadership at all levels in the restructuring of education through technology. ISTE's administrative sponsorship of the National Education Computing Conference (NECC) has played a prominent role in carrying out this mission.

A key ISTE program is its Private Sector Council, a model for working relationships with industry. The council, comprising a cross-section of business and educational society leaders, serves in an advisory capacity to the ISTE Board of Directors. ISTE believes that the alliance of industry and education enhances teaching materials, promotes excellence, and expands opportunities for educators and students alike.

ISTE also publishes *The Computing Teacher, Educational IRM (Information Resource Manager) Quarterly , Journal of Research on Computing in Education, ISTE Update, Microsoft Works inEducation* Newsletter, a wide range of special interest periodicals aimed at computer-using educators, and a comprehensive selection of books and courseware for administrators and classroom teachers.

Our Special Interest Groups (SIGS) focus on specific issues in educational technology and publish quarterly periodicals. Each SIG consists of a network of educators who share ideas, problems, and solutions in their particular area of expertise.

Sally A. Sloan, *President*

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Paul Resta, *International Initiatives*

Mr. BOUCHER. Thank you very much, Ms. Stout.

Mr. Masten?

Mr. MASTEN. Good afternoon, Mr. Chairman.

First, let me say that I was delighted to be elevated to doctor, but I respectfully decline. [Laughter.]

I also wanted to say that it's a privilege to appear after Major Owens, who is a tireless advocate of libraries and access to information.

And I would thank you for the opportunity to speak here today on the High Performance Computing and High Speed Networking Applications Act of 1993 and its impact on libraries. Let me start by applauding your recognition of the important role that public libraries play, must play, in the new information age. H.R. 1757 has the potential to be of historic significance in addressing the structural problems currently facing those libraries trying to ensure that the new networking technologies and the benefits they offer are accessible and usable by all citizens.

I offer you this view from the multiple perspectives of the New York Public Library, a unique, not-for-profit corporation with a public mission, founded in 1895, and we now comprise a network of 86 libraries with four world class research centers and 82 branch libraries in the neighborhoods of the Bronx, Manhattan, and Staten Island in New York. Our research libraries, with holdings of roughly 40 million items, are the only comprehensive research facilities in the United States other than the Library of Congress that are freely accessible to the public.

We have always been committed to free access to our resources regardless of the means or the affiliation of the user, and that strongly shapes our view of the national communications and information infrastructure. We think it is critically important that the development of national networks not divide the public, intentionally or unintentionally, into the information rich and the information poor. From the breadth of our experience with users in almost all subject areas and at all levels of sophistication, we strongly endorse one of H.R. 1757's major commitments: developing an array of user-friendly software tools to guide network users. And based on that same broad experience, we urge you to remember that libraries can help you realize the public benefits inherent in all of the areas that H.R. 1757 addresses. At all our sites, but especially at our planned Science, Industry and Business Library, which will open in 1995, we are intent on exploiting telecommunications and systems technologies to meet the needs of our users, in this case the needs of the business and scientific communities.

The Science, Industry and Business Library—or SIBL, as we call it—will have 100 multimedia workstations for the public connecting users to a full range of internal and external electronic resources, including Internet databases and electronic journals and bulletin boards. Our project needs track most of the proposed applications and development issues in your proposed legislation.

For example, we are designing user-friendly interfaces for patrons who walk through our doors to use our services or for those who reach us across country over the Internet. We are trying to find ways to fund the equipment, multiplexers, gateway processors, CD ROM players, and so on, and the associated software which must be in place for us to be a two-way window into Internet and that's not to mention the continuing charges for the dedicated connections to the Internet itself.

We are training our staff to use searching or navigational software on the national network to help our users. We are planning to build a special classroom and systems laboratory to teach our users how to master the electronic tools that will be at their disposal at this new center.

And, finally, we are wrestling with the reallocation of resources necessary to cover the costs of adding digital materials to our collections and mounting them for public use, or in some cases converting or scanning current print resources into digital formats.

These are challenges which we face, in fact, in every field in which we collect, and we are delighted to tell you that your draft bill contains provisions that would address every one of them.

Our basic plea today is that you recognize that to realize the promise of the electronic information revolution and the promise of a national network, those software applications you create, the connections to the national network you support, and the digital libraries that you would foster through this legislation should be distributed across the length and breadth of the network. Only in this way will you reach the public that we all hope to serve and tap the creativity and digital resources already in place across the country.

Thank you very much.

[The prepared statement of Mr. Masten follows:]

Statement of

Mr. John Masten
Chief Operating Officer
The New York Public Library

before the

Subcommittee on Science
Committee on Science, Space and Technology
U.S. House of Representatives
on the
High Performance Computing and
High Speed Networking
Applications Act of 1993, H.R. 1757

May 6, 1993

Mr. Chairman, members of the Subcommittee, thank you for the opportunity to testify before you today on the High Performance Computing and High Speed Networking Applications Act of 1993 and its impact on libraries.

I commend the Subcommittee for considering amendments to the High Performance Computing Act of 1991 to address specific applications of computing and networking technologies for libraries. I am particularly pleased at the thoroughness with which the bill addresses the structural problems facing public libraries in participating in the network technologies and the emphasis it puts on developing applications which are accessible and useable by all citizens. My comments today reflect the perspectives of a unique institution -- The New York Public Library. The New York Public Library (NYPL) is a private not-for-profit corporation with a public mission. Founded in 1895, it is a network of 86 libraries consisting of 4 world-renowned research centers and 82 branch circulating libraries in the neighborhoods of the Bronx, Manhattan, and Staten Island.

The Research Libraries, with holdings of more than 38 million items collected in more than 3,000 languages, are the only comprehensive research facilities in the United States, other than the Library of Congress, that are freely accessible to the public. Through its current research centers: the Central Research Library at 42nd Street in Manhattan, the Library for the Performing Arts at Lincoln Center, and the Schomburg Center for Research in Black Culture in Harlem, NYPL provides unique collections supporting research in almost every discipline.

The New York Public Library's commitment to free access (regardless of the means or the affiliation of the user) strongly shapes our view of how to construct and implement computer and networking technologies. We think it is critically important that the development of national networks not divide the public into two classes -- the information-rich and the information-poor. That is why we are so pleased that this legislation focuses on public access and on the role libraries play in ensuring that access through the development of networks. From the breadth of our experience with users, in almost all subject areas and at all levels of sophistication -- we strongly endorse one of the bill's major commitments -- developing an array of user-friendly software tools to guide network users.

SCIENCE, INDUSTRY AND BUSINESS LIBRARY

The NYPL is now embarked on a project to give democratic access new meaning in an era of intense technological change -- the Science, Industry and Business Library (SIBL). When it opens in 1995, SIBL will be the nation's largest public information center devoted solely to science and business. It is designed to exploit telecommunications and other systems to serve the needs of the business and scientific communities. The new $100 million center, which will combine NYPL's world class science and business collections, will be located in approximately 200,000 square feet on Madison Avenue in Manhattan. Construction has already begun on the site, which will house over 2 million volumes of research materials and a circulating collection of 80,000 books. It will provide seating for up to 500 users at a time, with each user place wired to data jacks that support readers' laptop computers.

An Electronic Information Center with 100 multimedia workstations will connect on-site and remote users to a full range of internal and external electronic resources, including INTERNET databases, and electronic journals and bulletin boards. (NYPL has already developed user friendly interfaces to make its electronic catalogs more easily available over the INTERNET). SIBL will actively promote and foster electronic literacy by providing a specially designated area to train users in the full range of its electronic tools and materials.

Dial-in remote access and document delivery will enable users in offices, educational institutions, libraries and homes throughout New York, the United States and the world to search for and identify materials throughout the Library's collections. SIBL will also be a critical vehicle for enhancing the dissemination of Federal information and documents. SIBL's technology-supported services are being developed in the Library's tradition of democratic public service -- addressing the information needs of people with all levels of technological sophistication, diverse economic circumstances and cultural backgrounds and divergent research needs *

Through networked links, each of our 82 branch libraries will be a window into SIBL's resources. And SIBL, through its links to the INTERNET and evolving data

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* A public library is a critical resource for economically and educationally disadvantaged people. SIBL will supplement and support the conventional business and educational systems that serve these groups, providing, through targeted services, such as small business information services, access to the information that is basic to individual and community development. This is a new twist to our historical role of aiding the entrance of new immigrants and minorities into the economic marketplace and the educational system.

highways, will be a nationally and internationally available resource for information on global markets and international trade. It will provide an unparalleled publicly-available resource for data on overseas markets. We believe that SIBL is an important model of how to encourage democratic, public access to the riches of a national network, and I will draw examples and comments on the proposed legislation from our experiences in planning it.

Though SIBL focuses on science and business, the same concerns have direct application to the humanities and social sciences, where large numbers of electronic databases exist and new ones are constantly being developed. The initiatives described in HR 1757 will be equally applicable and beneficial to all disciplines of research made available through libraries.

HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993

Libraries are a primary source of information for most Americans, and library participation in high-performance computing and high speed networking is essential to increasing access to such information. HR 1757 is an excellent start in addressing the constraints which affect the participation of libraries in, and the ability of users to benefit from, high performance computing and high-speed networking. Libraries of various types have a role in all of the program components outlined in this bill -- network access, research in support of applications and the development of applications for education, health care, libraries and government information. My comments will briefly focus on each component separately but it is important to recognize that these program elements are closely related.

First, as a matter of overall strategy, the collaborative fiscal approach of HR 1757 is both fiscally responsible and programmatically beneficial. Local cost sharing links the national effort to the local perspective and creativity that make networking plans truly responsive to regional and local needs. We have been active in local and statewide cooperative efforts to increase access to electronic information -- from development of a menu driven INTERNET gateway, to involvement in creating and distributing a simple access kit for small libraries and schools, to close work with New York State INTERNET Access Network (NYSERNET). Our experience makes us believers in using local and regional networks to reach the real needs of users.

NETWORK ACCESS (Section 306)

The network access provisions of HR 1757 help to ensure that there are unrestricted and ample entrance ramps to the information superhighway. The New York Public Library feels strongly that we should provide, indeed that public libraries should be supported in providing, points of access to national and international networks.

But the lack of funding for start-up equipment for libraries is one of the limiting factors for making initial connections to INTERNET and for creating local networks. We are extremely encouraged by the funding indicated in the network access provisions of HR 1757 to establish local networks and to acquire the necessary hardware. As any organization which maintains a systems function knows, the on-going costs in meeting constant advances in technology and in maintaining and upgrading hardware are major barriers to network participation.

I should also add that the cost of equipment to access the data highway is only the first major obstacle to network participation. The network will never be all it can be if the licensing costs to open, networked access to proprietary databases are not addressed. License and subscription fees can make the provision of open access to a full range of databases impractical if there is no provision for cost recovery by libraries. This is clear to us in our planning for SIBL. Yet those same fees may discourage public access to that very information. This is a conundrum which faces all of us who seek to broaden rather than restrict access to information.

Finally, a key element to promoting electronic literacy is the core role of librarians as facilitators for finding and relaying information. We are pleased that HR 1757 recognizes that role, and specifies that the plan include programs to train librarians in the use of computer networks and the INTERNET. Towards that end, NYPL currently trains staff in searching and navigational techniques necessary to efficiently identify and retrieve information from the INTERNET resources. Without this training, our staff could not do their jobs.

RESEARCH IN SUPPORT OF APPLICATIONS (Section 307)

Libraries serve users with varying degrees of technological sophistication, and the bill's provisions to develop and demonstrate user interfaces to simplify access to the use of INTERNET by non-specialists is critical to equality of access to information. Developing these aids, of course, is crucial to ensuring that the information in the network is available at all. First, the non-specialist (and often even the specialist) must get on to the INTERNET or network, and then find out what is available on the network. Interfaces must be designed so that the computer starts a dialogue with the user to direct them to the resources which will answer their questions. Once the user gets into the specific resources, there may be a different set of protocols to gain access to the information. Those different sets of user instructions must be "normalized" to a familiar standard format to allow the user to be able to work through a range of resources. Each of these steps is critical to broadening the reach of the networks beyond a select and sophisticated user group.

APPLICATIONS FOR EDUCATION (Section 308)

From our perspective, naturally, applications in education necessarily include libraries. Much of our energy is devoted to supporting our local educational system as well as the lifelong learning that goes on within our walls. In the Science, Industry and Business Library, for example, we plan to set up prototype partnerships with educational institutions to enrich the information and technology resources available in and out of the classroom. One of the targeted programs of SIBL -- partnerships with science education -- will focus on the educational and training needs of the next generation's workforce. We are actively considering programs such as information transfer to the science magnet schools, programs to facilitate participation in science fairs and competitions, and serving as a technology resource for high school or middle school science teachers. In each of these instances we mean to draw on the resources of a national network to meet our goals.

In addition to SIBL's targeted programs for science education, NYPL is the de facto library for the public elementary schools in the three boroughs that we serve in New York City. Moreover, for over a decade, NYPL has worked with the New York City Board of Education to convert their high school libraries' holdings into machine-readable form. We have also served as their online union catalog, permitting the various school libraries to dial in to our computer center in order to locate their own materials.

NYPL serves, as do all public libraries, as a vehicle for lifelong learning. Essential to the development of computer systems, software and networks for lifelong education is the accessibility of that technology to the user. NYPL Branch Libraries offer microcomputers directly to the public in nearly fifty branches, with software relevant to education, jobs and self-improvement. In addition, we have a microcomputer page program in which teenagers provide instruction and training to library patrons on both the hardware and software of the microcomputers in their branch. This program has literally opened up a new world to many library users who had no experience with computers.

APPLICATIONS FOR HEALTH CARE (Section 309)

The 82 branches of The New York Public Libraries serve as a critical local resource for consumer health information. Citizens seeking information on health services ranging from alcoholism to long-term health care can use the Community Information Service (CIS), a directory of agencies in the New York City area providing social and health services. CIS is currently in a printed book format but will be available electronically in all 82 branches when we implement our integrated on-line public access catalog over the next two years. In addition, our branch library collections are rich in materials in consumer health information -- from general directories of physicians, to medical dictionaries, to medication reference materials. In our role as an information provider, we are excited by the bill's provision to develop consumer-oriented, multimedia materials.

APPLICATIONS FOR LIBRARIES (Section 310)

The bill's approach to library applications focusses on digital libraries - which we take to mean collections of digital source materials or text not just bibliographic data, together with the ability to offer both on-site and remote access to such materials. We agree with the list of activities identified in the draft legislation as being crucial to the handling and manipulation of digital data.

As a practical matter, managing the growth of machine readable data in libraries covers the spectrum from the most basic level of digitizing bibliographic catalogs to the complete digitization of texts from the printed resources contained in library collections. The digitization of libraries must move on at least two tracks, each of which will require extensive allocation of resources. The first is to reeducate staff and to reequip libraries so that they can be prepared to handle sharply increasing volumes of digital information. From now on, the amount of new information that will be available in digital form will grow exponentially. Libraries must be in a position to acquire, process and make accessible this growing mass of digital information, as well as provide access to digital databases that develop elsewhere on the network. The second track is to look at the conversion to digital form of key elements of existing collections and provide libraries with the tools to preserve and integrate those materials into the network environment.

We feel strongly that the legislation must address the practical issues that face operating libraries. For it is surely a fact that the digital library of the future will never exist in one place but rather will be assembled from all the digital sources throughout the network. The richest resources will only be available on the national network if the creation of digital libraries is fostered at multiple points across the country.

APPLICATIONS FOR GOVERNMENT INFORMATION (Section 311)

Libraries have traditionally served as an ideal conduit for the dissemination of government information. As depositories for government documents, libraries provide the single most comprehensive source for government information. We strongly support the provisions contained in this legislation for improving access to federal, state and local government information and urge that that improved access be made without an increased cost to libraries.

CONCLUSION

Thank you again for the opportunity to testify before you today. I look forward to working with the Committee in the development of applications of computing and networking technologies for libraries. We share a great challenge. The changes brought about by the concurrent explosions in computing and communications technologies are for libraries no less important than the changes wrought by the printing press and the first cataloging systems: each holds the potential for vastly enlarging the availability of the world's recorded knowledge for an ever-widening circle of users.

Mr. BOUCHER. Thank you very much, Mr. Masten.

Unfortunately, we just received a call of the House, which means that Members have to report to the floor in order to vote. Ordinarily, I would ask that another Member chair this hearing and continue while I'm gone. For obvious reasons, that's not possible at the moment. So I'm going to declare a brief recess for about 10 minutes, and as soon as we return, we'll hear from Dr. Massengale.

[Recess.]

Mr. BOUCHER. Sorry for the delay. The subcommittee will reconvene.

And Dr. Massengale, we'll be pleased to hear from you.

Dr. MASSENGALE. Well, thank you, Chairman Boucher.

I am Martin Massengale, President of the University of Nebraska. I'm both honored and pleased to be here this afternoon to appear before the committee and represent the National Association of State Universities and Land Grant Colleges. The testimony that I present today also has the endorsement of several other key educational and library associations.

First, I'd like to commend this committee for its leadership and vision, as it sets the pace that will accelerate the development and dissemination of applications of high performance computing and networking. In my own State, new information service, provided through the support of the National Science Foundation, has made a significant difference in the quality of education and the productivity of our faculty. The increase in collaborative opportunities and the greater access to libraries have both been extremely helpful.

Also, we helped support the development of an organization called MIDNET. And while it's called a network, it's an extraordinary cooperative venture reaching seven different states. Organizations such as MIDNET, known as mid-level networks, receive some initial support from NSF, but we're funded primarily by universities, memberships, and states, and they've played a vital role in the diffusion of the new technology to small campuses, libraries, and schools.

One example of the use of MIDNET and Internet in Nebraska is the program for women in science education. One of the problems in attracting young women to science and engineering is to trigger that interest at an early age. The program starts in the fifth grade where the young women are selected from throughout rural Nebraska for summer workshops. They are matched with mentors who may be far away from that rural location, but following the summer workshop they are coupled by our computers and Internet access.

Let me also indicate that universities, colleges, libraries, communities, and states are proud of their contribution to the evolution of Internet. The small amount of Federal dollars and its appropriate role as a stimulus has served to create an international marketplace with new jobs and services worth billions of dollars to our country.

The Federal and university investments are crucial in creating and developing the technology and services which have led to commercial interest. The universities and colleges expect to fill an increasing percentage of their network needs from the commercial sector.

We understand that there are concerns that university and Federal networking activities will interfere with privately-operated commercial networks and that the Internet is something separate from a public switch network. In actuality, they all work together.

The telephone lines connecting the campuses to the mid-level networks and the mid-level connections to NSFnet are leased from regional and local telephone companies and interexchange carriers. I believe that universities and Federal agencies have helped to do the research and developmental work necessary to fill the void where the telecommunications industry was not able to address the need for local and nationwide high speed information services.

Now we need to understand that this market failure has its roots at least in part because of the regulatory process. It's my understanding that Congress is now beginning to explore potential options associated with creating a regulatory and competitive environment consistent with the needs of an evolving National Information Infrastructure. The investment in information services infrastructure represented by the NSF backbone affects the nature of public investment that tends to lead to market creation.

Today we're just beginning to realize the potential of the Internet for strengthening our education and research missions. The Internet has become a crucially important research and education tool widely used by students and scholars. There is a shared excitement among my colleagues in academia as we begin to explore the many ways in which a true national research and education network will enhance the learning process. In this sense, we are very enthusiastic supporters of the objectives of H.R. 1757 in stimulating the development of applications for the use of Internet.

There is, however, considerable degree of concern over section 5 of the bill where amendments to the High Performance Computing Act of 1991 are made. The amendments in section 5 setting a rigid time table for change in the current structure for Internet support omits considerations of key cost and technology issues, and it's crucial that there should be broad access to commercial network services for educational and research institutions at an affordable cost.

Now developmental nature and rapid expansion of the Internet will require careful exploration of the transition options and plans. And my colleagues at EDUCOM are preparing a response with some specific language for your committee which will be for your consideration, and we'll be submitting that within the next day.

Mr. Chairman, let me indicate that 25 years ago the Federal Government, industry, and universities determined that there was a chance that our scientific and research capabilities would lag if we failed to take advantage of the computer revolution. The National Science Foundation administered a capital stimulus program that provided incentives for states and universities to purchase early computer systems. There was another element, and that is that the computer industry provided significant discounts at that time to enhance the program, and it worked.

And, finally, in summary, let me say that, first, we feel that the committee has taken an important step in formulating a policy for stimulating critical applications. Second, we're concerned that accessibility and affordability to be major considerations in setting any time table for transition. And, thirdly, we look forward to working together with you as we refine the expression of the policy that will meet higher education's needs and continue to expand the National Information Infrastructure.

The Federal investment in the network infrastructure has achieved great success, and now it is a key supporting element in America's educational and research productivity. It is fragile, and let us not lose the momentum that we've gained thus far.

Thank you very much.

[The prepared statement of Dr. Massengale follows:]

STATEMENT OF

Martin A. Massengale
President, University of Nebraska
and Chair, National Association of State Universities
and Land-Grant Colleges
Commission on Information Technologies

ON H.R. 1757

The "High Performance Computing and High Speed
Networking Applications Act of 1993"

BEFORE THE

United States House of Representatives
Subcommittee on Science
Committee on Science, Space and Technology

May 6, 1993

Thank you Chairman Boucher and members of the Committee. My name is Martin Massengale, and I am the President of the University of Nebraska. I am honored and pleased to have this opportunity to appear before the Committee and represent the National Association of State Universities and Land-Grant Colleges, of which I am both a member of the Board of Directors and Chair of the Commission on Information Technologies. The testimony I present today also has the endorsement of other key educational and library organizations including the Association of American Universities, EDUCOM, the American Library Association, the Association of Research Libraries, and others.

This Committee should be commended for its leadership and vision as it sets the pace for the next steps that will accelerate the development and dissemination of applications of high performance computing and networking. In my state, new information services, provided through the support of the National Science Foundation, have made a significant difference in the quality of education and the productivity of the faculty. The increase in collaborative opportunities and greater access to libraries have been extremely helpful. These technologies have allowed our three state colleges and the two universities to be interlinked and appear as one library system to the faculty and students.

Also, we helped support the development of an organization called MIDNET. While it is called a network, it is an extraordinary cooperative effort reaching seven states. Dr. Douglas Gale, Director of MIDNET, explained that it is a consortium that provides these services:

a) aggregates needed telephone data services and negotiates with the local operating companies and interexchange carriers for services to member campuses,

b) purchases and installs hardware and software needed to support packet switching and connection to the Internet,

c) provides operational monitoring and supports questions and answers about services,

d) provides people to train and educate colleges and schools in the applications and use of Internet,

e) aggregates needs for purchase of information services, such as specialized data bases, to allow discounts, and

f) provides support for user groups and collaboration among schools for development of software, and experiments with curriculums, etc.

Organizations such as MIDNET (known as mid-level networks), received some initial support from NSF, but were funded primarily by universities, memberships and states, have played a vital role in the diffusion of the new technology to small campuses, libraries and schools. We are serving campuses which are not in the major metropolitan areas and where there are no options for commercial services that match their needs.

One example of the use of the MIDNET and Internet in Nebraska is the Program for Women in Science Education. One of the problems in attracting young women to science and engineering is to trigger that interest at an early stage. The program starts in the fifth grade where the young women are selected from throughout Nebraska for training in summer camps. They are matched with mentors who may be far from their rural location, but following the summer camp they are coupled with computers and Internet access through Lincoln. This has allowed the necessary supportive environment.

Universities, colleges, library communities, and states are proud of their contribution to the evolution of the Internet. A small amount of Federal dollars, in its appropriate role as stimulus, has served to create a new international marketplace with new jobs and services worth billions of dollars to the country. Those dollars have been also matched by a factor of ten to one by the universities and states and spent on computing equipment and telephone services.

The federal and university investments were crucial in creating and developing the technology and services which have led to commercial entries. The universities and colleges expect to fill an increasing percentage of their network needs from the commercial sector.

Originally, these information services were developed in order to meet the needs in education and research for cost effective ways of moving information at high speeds and the diffusion of these tools throughout higher education. These public interest goals are crucial and are not necessarily the same goals for private commercial networks.

We understand that there are concerns that university and federal networking activities will interfere with privately operated commercial networks, and that the Internet is something separate from the public switched network. In actuality, they all work together. The telephone lines connecting the campuses to the mid-level networks and the mid-level connections to the NSFnet are leased from regional, local telephone companies and interexchange carriers.

I believe that universities and federal agencies have helped to do the research and developmental work necessary to fill the void where the telecommunications industry was not able to address the need for local and nationwide high-speed information services. We do understand that this market failure has its roots in both the regulatory process and the attitudes toward the need for innovation. We know that many in Congress are beginning to explore the potential options associated with creating a regulatory and competitive environment consistent with the needs of an evolving National Information Infrastructure. The investment in information services infrastructure represented by the NSF backbone reflects the nature of public investment that leads to market creation. The thirty million dollar NSF investment (and the state and university matches) in pre-competitive technology continues to pull the market along.

Today we are just beginning to realize the potential of the Internet for strengthening our education and research missions. The Internet has become a crucially important research and education tool widely used by students, scholars, and yes, even a few college presidents. There is shared excitement among my colleagues in academia as we begin to explore the many ways in which a true National Research and Education Network program will enhance the learning process. In this sense, we enthusiastically support the objectives of H.R. 1757 in stimulating the development of applications for the use of the Internet.

We feel that the Committee has made a significant advance by clarifying the language about the NREN versus the NREN program. There is, however, a considerable degree of concern over Section 5 of the bill where the amendments to the High Performance Computing Act of 1991 are made. The amendments in Section 5, setting a rigid timetable for change in the current structure for Internet support, omit consideration of key cost and technology issues. It is critical that there should be broad access to commercial network services for educational and research institutions at affordable prices.

In our opinion, then, this section should take into account performance based tests such as price, accessibility, breadth of service, competitive options, availability, ubiquity, and timing. The developmental nature and rapid expansion of the Internet will require careful exploration of the transition options and plans. Without these considerations, the amendments may unnecessarily restrict federal and state government actions in the public interest. The definition of separation of test bed from production must insure that a faculty member will not have to have multiple work-stations connected to multiple networks. We would be glad to work with the Committee further to develop clarifying bill and report language.

Twenty five years ago, the federal government, industry, and universities determined that there was a chance that our scientific and research capabilities would lag if we failed to take advantage of the computer revolution. The National Science Foundation administered a capital stimulus program that provided incentives for states and universities to purchase the early computer systems. There was another element - the computer industry provided significant discounts at the same time to enhance the program. It worked. I note that the computer industry still identifies the education community as one where it has continued to offer support through both hardware and software discounts. They also see this support as paying off in the development of new markets. We are looking forward to collaborating with the telecommunications industry in the same way.

In summary,

a) we feel that the Committee has taken an important step in formulating a policy for stimulating critical applications;

b) we are concerned that accessibility and affordability be major considerations in setting any timetable for transition;

c) we look forward to working together with you to refine the expression of the policy that will meet higher education's needs and continue to expand the National Information Infrastructure.

The federal investment in the network infrastructure has achieved great success and now is a key supporting element in America's educational and research productivity. It is fragile; let us not lose the momentum that we have gained .

I will be glad to answer any questions.

National Association of State Universities and Land-Grant

Founded in 1887, the National Association of State Universities and Land-Grant Colleges (NASULGC) is the nation's oldest higher education association. A voluntary association of public research universities, all the land-grant institutions and many state university systems, NASULGC's membership includes 166 institutions, and its campuses are located in all 50 states and the U.S. territories. Its member campuses enroll more than 2.6 million students and claim upwards of 20 million alumni. NASULGC institutions award approximately a half-million degrees annually, including about one-third of all bachelor's and master's degrees, 60 percent of all U.S. doctoral degrees, and 70 percent of the nation's engineering degrees.

Commission on Information Technologies

NASULGC's Commission on Information Technologies works on the changes in teaching, learning, communications, information creation, storage and retrieval and the operations of libraries which are increasingly driven and influenced by technology. The commission develops NASULGC policies and positions in specific areas such as high performance computing and networks.

Mr. BOUCHER. Thank you very much, Dr. Massengale.

Ms. Braddon.

Ms. BRADDON. Thank you and good afternoon.

I appreciate the opportunity to provide the views of the Information Industry Association on H.R. 1757. I am Cynthia Braddon, Vice President of Washington Affairs of McGraw-Hill, a multimedia publishing and information services company serving worldwide markets in education, business, industry, and government. I'm here today in my capacity as chair of the Public Policy and Government Relations Council of the Information Industry Association.

IIA is the trade association of 500 leading companies that create, distribute, and use information products and services and technologies. Our common theme is information, and delivering it to the customer in many formats and many different media. What we want to do is provide the information that my fellow panelists need to perform their functions.

In this short time, I want to highlight IIA's support for your efforts, Mr. Chairman, and urge you to address some of our concerns in order to make this vision of the National Information Infrastructure a reality. We believe it is critical to get the rules of the road correct in order to foster the most efficient, effective, and ubiquitous information delivery system possible. H.R. 1757 makes a significant step in that direction. We vigorously support your view of a public and private sector partnership as essential in developing the applications and achieving the goals articulated by the administration and in your legislation.

But one key piece of this complex puzzle seems to be missing: information content. After all the high speed networks are built, all the leading-edge switches and routers are installed, all the hardware and software are put in place, the advanced information infrastructure will need one more element for it to realize its potential, and that is information. Without accessible and useful information content, the high performance network could be a high-priced disappointment for the millions of Americans who should be its beneficiaries. The field can be built, but information providers will not come to play unless the rules are fair and their investment can be protected.

Information is created from a wide variety of sources, but it usually becomes useful and valuable only after a considerable investment of energy, resources, and creativity. And without the value added by editing, selecting, formatting, and making that raw data useful to the user, all you have is noise.

Information providers must have safeguards for this investment before they risk having their information products shoplifted, altered, and redisseminated without authorization. Therefore, we believe it's essential that H.R. 1757 state government's goal in this area, to foster a competitive marketplace in the information services arena. Government support for research and development should be aimed at advancing this goal. This means that part of the R&D efforts should be targeted at the problems which must be resolved in order to achieve the maximum information provider participation in the network.

Just two examples: first, effective copyright protection is a key incentive. We are not asking for a change in the copyright law, but management of intellectual property should be specifically targeted as a priority area for research programs, particularly in the realm of digital libraries. The issue is closely allied to the security, privacy, and data integrity concerns identified in your bill. New research could build on exciting projects that are already underway in that field.

Secondly, please provide some policy leadership that can balance the roles of government and the private sector in the dissemination of government information. What you do in this area will mean the difference between many competing sources of public information and a single government information source controlled by the government.

Finally, a key mechanism for public input is the advisory committee created by the 1991 High Performance Computing Act. The previous administration, unfortunately, never got around to appointing it. We know a new page has been turned, but we urge Congress to set a deadline to get this advisory committee up and going.

Mr. Chairman, thank you for inviting IIA to present its views, and I'd be happy to answer any questions.

[The prepared statement of Ms. Braddon follows:]

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STATEMENT OF CYNTHIA H. BRADDON

Vice President, Washington Affairs
McGraw-Hill, Inc.

on behalf of

INFORMATION INDUSTRY ASSOCIATION

before the Subcommittee on Science

Committee on Science, Space and Technology

United States House of Representatives

on H.R. 1757

High Performance Computing and

High Speed Networking Applications Act of 1993

May 6, 1993

Mr. Chairman, and members of the Subcommittee:

Thank you for this opportunity to present the comments of the Information Industry Association on H.R. 1757, the High Performance Computing and High Speed Networking Applications Act of 1993.

I am Cynthia Braddon, Vice President for Washington Affairs of McGraw-Hill, Inc., a multimedia publishing and information services company, serving worldwide markets in education, business, industry and government. I am here today in my capacity as chair of the Public Policy and Government Relations Council of the Information Industry Association (IIA).

IIA is the trade association of leading companies that create, distribute, and use information products, services, and technologies. Our 500 member companies range from large global corporations to entrepreneurial start-ups, and include traditional and electronic publishers, database producers and providers, interactive electronic services (audio and video), computer manufacturers, software developers, financial information services, and telecommunications providers. Among this diverse group of businesses, the common theme is the value of information, delivered to the customer in many forms and through a variety of media.

It's not surprising, therefore, that IIA has been actively involved for some years in the debate about the government's role in the evolving information infrastructure. Information companies believe we have a crucial stake in the outcome. That debate has moved rapidly toward center stage in recent years. Today, these issues are high on the agenda of both the legislative and executive branches of government. I can also tell you, Mr. Chairman, that they are sparking vigorous debate among and within information companies such as McGraw-Hill. That is why, for example, I am pleased to serve on the National Academy of Sciences panel that is charged with recommending the future development of the National Research and Education Network (NREN).

H.R. 1757 marks a significant advance in the seriousness and concreteness of this debate. Mr. Chairman, your bill recognizes that the American people will not be able to reap the full potential of the breathtaking advances in computing and communications technology until we tackle and solve some tough problems in specific applications areas. We commend your effort to identify these applications priorities, and to propose a streamlined, collaborative government-industry initiative to address them.

The Value of Information Content

Many of us in the information industry therefore applaud what we see in H.R. 1757. But I must tell you, Mr. Chairman, that many of us are also concerned about what we do not clearly see in the bill. H.R. 1757 brings many of the pieces of the complex puzzle into focus, but one key piece remains blurred: the value of information content.

After all the high-speed networks are built, all the leading-edge switches and routers are installed, all the hardware and sofware are put in place, the advanced information infrastructure will need one more element to realize its potential: information. Without accessible and useful information content, the high performance network could be a high priced disappointment to millions of Americans who are its potential beneficiaries.

This information content will not simply materialize on the screens of computers hooked up to the Internet or other, more advanced computer networks. Information comes from a wide variety of sources, but it usually becomes useful and valuable only after a considerable investment of energy, resources, and creativity. I know this because that investment is my company's business, and the business of hundreds of other large and small companies in the information industry.

IIA members develop and distribute innovative and authoritative information products and services to meet the information needs of American businesses, professionals, researchers and consumers. We also invest millions of dollars in research and development to find better ways to create, collect, organize, enhance, and distribute information to these diverse markets. Without these activities, the advanced information infrastructure will fall short of delivering its promised benefits. Authorizing legislation must adequately recognize and take into account this essential contribution to our national goal.

The Goal: Fostering Competitive Information Services

Let me give one example of my concern. Section 5 of H.R. 1757 rewrites the NREN provisions of the 1991 High Performance Computing Act (HPCA). Proposed section 102(d) of the HPCA embodies an important principle that was not as clearly recognized in the 1991 legislation: government-supported test bed networks should not be used to supplant or compete with privately operated commercial networks. This principle makes sense, because there is already a thriving and competitive private sector marketplace in network services. Government should foster, not distort, that competitive marketplace.

IIA fully supports this aspect of H.R. 1757. It is consistent with the policy principles on telecommunications infrastructure development which IIA has developed and debated over the past year (attached as an exhibit to this testimony). But we note with concern that the bill does not take the same approach with regard to information services, where a similar situation exists.

There is already a thriving and competitive private sector marketplace in information services. Our information industry is diverse and dynamic, the strongest in the world. Corporations, non-profit institutions, and other players compete to keep Americans well-informed. This is an information marketplace that government should acknowledge, foster and promote. Yet nowhere in H.R. 1757 do we find a commitment to encourage competitive information services parallel to the commitment to competitive networks.

These two situations are not identical, of course. But they are similar. Let me be clear: We do not advocate that government be banned from providing any information service that "could be provided satisfactorily" by the private sector. But we do believe that government's goal should be to foster a competitive marketplace in information services. That goal should be clearly stated in law.

More importantly, we believe that government support for pre–competitive research and development should be aimed at advancing this goal. It should be targeted at the problems which threaten the future of competition in information products and services, and should take into account the development efforts now underway among information companies in the private sector to meet the growing information demands of the American public.

IIA applauds the proposal to develop a federal plan to foster computing and network applications. We are especially pleased that your bill clearly delineates who is in charge of most aspects of this plan, beginning with the requirement for designation of a single coordinator for federal activities both under the 1991 HPCA and under the new legislation. This approach could eliminate, in one fell swoop, one of the main reasons why, at least from the private sector perspective, implementation of the HPCA has been so ineffective and so frustrating. We are heartened by this sign that the bureaucratic fog may be lifting.

Proposed sections 307 through 311 identify many of the major applications challenges that government can help to solve. IIA believes that two areas need further attention, however: the protection and management of intellectual property, and the policy issues surrounding the dissemination of government information.

Intellectual Property Protection and Management

On the first issue, let me be blunt. Through the years, I have noticed that some advocates for advanced information networks are very uncomfortable about copyright. They do not understand it, they do not like it, and they view it as a "problem." Mr. Chairman, they are wrong, and your bill should say so.

Copyright is not a "problem" in the development of information infrastructure any more than beating egg whites is a "problem" in making a meringue: it may not be easy, but you have to do it to achieve the desired result. As you well know, Mr. Chairman, copyright is the legal incentive that our Constitution and our laws provide for the creation of works of authorship. It is an extraordinarily powerful and effective incentive: strong copyright protection is one of the main reasons why the rest of the world envies our leadership in computer software, commercial databases, and other information markets.

The same reasoning applies to most of the information that makes a high performance network so valuable. If copyright cannot be protected in this environment, then the supply of useful information will be drastically curtailed — or, just as troubling, it will be limited to the information that government or some other powerful institution chooses to create.

No supplier would be eager to showcase its wares in a marketplace where shoplifters are welcomed. Similarly, there are some technological problems — and some cultural predilections — that must be confronted if non-governmental information providers are to be fully comfortable with Internet and other huge computer networks as distribution channels for their products and services.

IIA believes these problems can be solved, but they must first be recognized. H.R. 1757, as currently drafted, does not do this. It eliminates many of the references to copyright from the existing High Performance Computing Act, and assiduously avoids any mention of it in the new provisions on applications. As a result, it fails to focus on one of the key ingredients for making advanced information infrastructure a success.

For instance, in section 307(b), protection and management of intellectual property should be specifically targeted as a priority area for pre-competitive research programs. The intellectual property issues are closely allied to the security, privacy, and data integrity concerns already identified in this section. Making data more secure will help prevent copyright infringement as well as eavesdropping and espionage; effectively encapsulating data will help tag its ownership as well as protect its integrity. Intellectual property management presents some additional challenges: to license, monitor, and account for a user's spontaneous access to information, for example, rather than simply to prevent it. New research could build on the exciting projects now underway in this field, including some in which IIA is participating. In addition, the thrust of this section should not be limited to Internet, but should also authorize intellectual property management research applicable to other computer networks.

Copyright issues are also important in the educational environment addressed by section 308. But the absence of these issues is most conspicuous in section 310, dealing with library applications.

"Digital libraries" already exist, of course, and millions of people already have access to them. Today's database services, such as those offered by companies such as Dialog, Dow Jones, Mead Data Central, and other IIA member companies, consist of digitized information from a variety of sources and in a range of formats, brought together with a common user interface, indexing and finding aids, and extensive user support. All of the research and development challenges listed in section 310(b) are important to the effort to build the even more advanced "digital libraries" of the future. IIA member companies are already investing in many of these areas — especially training, advanced database software, and integration of information in different formats -- in order to meet existing customer needs and gain a competitive edge for the future. But it ignores reality to overlook the impact of some of these technologies upon the protection and management of intellectual property.

For instance, high-performance scanning and digitization technology (section 310(b)(2)) is essential to the development of advanced digital libraries. But if not managed wisely, this technology also threatens to destroy effective copyright protection for printed materials, photographic images, and other works. The ability to make a perfect digital copy, accessible instantly to millions of users worldwide, is an exciting prospect, but it can also be a license to steal intellectual property cheaply, easily, and in a way that destroys any incentive for future creativity. The federal government should take a balanced approach that encourages new technology while preserving the crucial incentives that copyright provides.

Mr. Chairman, I know that the copyright issues among information providers and libraries are complex and contentious, and that they cannot be resolved solely through technological means. But technology certainly could be part of the solution, if it combines a mechanism for facilitating access to copyrighted digitized works with fair compensation to intellectual property owners. For that reason, we urge you to add the development and implementation of such mechanisms to the list of library applications included in section 310.

This is not a peripheral issue, but a central challenge in the evolution of advanced digital libraries. I believe my library colleagues would agree with me that this issue deserves more attention.

My final point with regard to copyright concerns the changes H.R. 1757 would make to the existing HPCA. As passed in 1991, section 102 of HPCA specified that the NREN should "be designed and operated so as to ensure the continued application of laws [protecting] copyright and other intellectual property rights," and should "have accounting mechanisms which allow users or groups of users to be charged for their usage of copyrighted materials." We are pleased to see that H.R. 1757 carries these provisions forward with regard to the test bed networks that comprise one part of the reconfigured NREN program.

However, the test bed networks are not the only networks impacted by federal activities. The government should retain a responsibility to promote compliance with copyright in any network that enjoys direct or indirect federal assistance, especially the Internet, which under this legislation would benefit from considerable additional federal funding for connectivity, promotion of information services, and applications, including the prototype digital libraries. Unless this is clarified, the HPCA amendments could be perceived as a lessening of federal concern for copyright protection and management as an indispensable element of infrastructure development.

In the same vein, we note that the requirement in section 102(g) of the HPCA for a report to Congress on developments in copyright protection and accounting mechanisms has not been renewed. Although IIA was extremely disappointed in the treatment OSTP accorded copyright in its 1992 report under this section, there may be some benefit in requiring an annual report to Congress on progress in these critical areas. This provides another opportunity for Congress to underscore the importance of copyright if the advanced information infrastructure is to realize its full potential.

Government Information Dissemination

Proposed section 311 builds upon the initiative announced by President Clinton and Vice President Gore on February 22 as part of the Administration's technology plan. This plan cited the economic value of information held by the federal government, and called for "using new computer and networking technology to make this information more available to the taxpayers who paid for it." IIA supports this goal and welcomes this initiative to achieve it. However, we believe that section 311, more than any other portion of this bill, fails to fully acknowledge and build upon the activities of the private sector information industry. It also omits an essential element of the President's technology plan, which noted that "it will require consistent federal information policies designed to ensure that federal information is made available at a fair price to as many users as possible while encouraging growth of the information industry."

It makes sense for federal agencies to be aware of advances in information and communications technologies that affect their information dissemination functions, and to take advantage of these changes where appropriate. But, in sharp contrast to the other applications areas addressed by H.R. 1757, the main challenges here are not technological. They are questions of policy, of goals, of commitment.

To understand our concerns, it may be helpful to explain the role that non-governmental information providers play today in dissemination of government information.

Many IIA member companies (along with non-profit institutions and other private sector entities) offer information products and services based on, or including, information originating with the federal government. These companies enhance this information in a variety of ways: by selecting, assembling and editing government information; by arranging and organizing it in useful ways; by combining it with information from other sources; by adding indexing, cross-referencing, and annotations; and by updating and expanding these databases to make sure that they are comprehensive, timely, and accurate. Information companies then distribute these enhanced products to the public in convenient, useful and user-friendly formats — including hard copy, microform, and a range of electronic dissemination media, such as on-line and in CD-ROM. Whatever the medium, companies provide ongoing customer service to make sure that the customers' information needs are being satisfied to the greatest extent possible.

Through this three-step process — value-added production, multiple distribution channels, and ongoing customer service — information companies play a key role in promoting and enhancing public access to public information, and in bringing this information to ever broader publics. These markets include researchers seeking the most current scientific and technical data; economists and marketers needing demographic or statistical information; professionals demanding current legal or medical developments; and citizens seeking to participate in all aspects of the democratic process.

While H.R. 1757 and the President's technology plan accurately note that much government information is underutilized, it is worth reminding ourselves how successful the current system has been in making public information available. By almost any measure, the American public is far better informed about government and its activities than the citizens of any other country. The difference is due in great part to policies that recognize the importance of a robust, competitive private sector as a key element in the dissemination of public information.

In our system, citizens are entitled to access to public information, from a diversity of sources, in a variety of formats, free from unwarranted government restrictions and control. The information industry has thrived under these principles, but more importantly, so has the American economy and our democracy.

Revolutionary advances in new technology will certainly change the specific roles of government and the private sector in disseminating government information. But they must not be allowed to become an excuse for unbalancing those roles or obliterating the contribution the private sector now makes to informing the public.

A $118 million program to promote the dissemination of public information, as proposed by H.R. 1757, is sure to have some impact on the respective roles of government and the private sector. The impact could be synergistic, or it could be destructive. It could widen the choices of useful, timely, and accurate information available to the American public, or it could drive private investment from the government information marketplace, leaving the federal government the only player and the public less well served as a result.

The outcome will depend upon the policy framework under which the program is implemented. In recent years, a growing consensus has emerged around fundamental government information policy principles, including a commitment to:

- ** Assure equal and timely access to public information in all available media;
- ** Prohibit government agencies from charging fees for public information in excess of the marginal cost of distribution;
- ** Prevent any entity, public or private, from exercising monopoly control over public information;
- ** Forbid government agencies to assert copyright or similar controls over public information;
- ** Promote a diversity of sources — both public and private — for public information;
- ** Guarantee the public an opportunity to participate in government decisions affecting public access to information.

Many of these principles were reflected in legislation passed by the House in 1990, and in other proposals for government information policy guidelines. If the initiative set forth in section 311 is to achieve its goals, it should embody these principles as well.

The key is strong policy control. In its current form, section 311 could be read as an invitation to throw money at the wrong problem. It sets no criteria for evaluating which projects to pursue and which to avoid. A few simple amendments could fill this gap. These include the following:

*** While agencies should be encouraged to apply the new technology flexibly to the information they seek to disseminate, a lead agency or office must be designated and empowered to set policy guidelines.

*** The section should be amended to reflect the essential role of non-governmental entities in enabling public access to information held by the government. Although the references to "related resources" and "guidance" in sections 310(b) and (c) could be read to embrace non-governmental channels of distribution, this should be made explicit.

*** An inventory and assessment of ongoing private sector activities to enhance public access to public information should precede project support decisions, to help set priorities, promote public-private sector collaboration, and ensure that federal funds are spent wisely.

*** Finally, in any agency initiatives under this section, the competitive impact on other sources of information must be taken into account.

To repeat, your bill already provides in the network services area that where the private sector is capable of meeting public needs, the government should stay out. What we seek in the information services field is similar but more limited. We know that the government has an essential role to play as an information provider, and we do not seek to prevent agencies from taking advantage of new technology in order to carry out their responsibilities. But we strongly believe that government should be required to consider how its dissemination initiatives will impact the considerable non-governmental investment in providing the public with access to public information. Without this consideration, the sums authorized by section 311 could be entirely counter-productive to the goal of enhancing that access.

I have one additional observation. A valuable by-product of this program could be to bring state and local governments into conformity with sound information policy practices on the federal level. At a minimum, state and local governments should be prohibited from asserting copyright in public information they provide in projects funded under this section. This would mirror the existing prohibition on copyright in works of the federal government (17 U.S.C. 105).

Additional HPCA Issues

IIA is still studying sections 4 and 5 of H.R. 1757, which substantially rewrite portions of the 1991 HPCA. We do have a few comments to offer at this time, two of which concern the statutory advisory committee.

Of the many disappointments in implementation of the 1991 Act by the previous Administration, few were more distressing than the failure to constitute the High Performance Computing Advisory Committee established by section 101(b) of HPCA. This failure deprived the OSTP director, and indirectly deprived Congress as well, of the "independent assessment" of HPCA implementation that Congress considered so important. We commend you for carrying forward this advisory committee, now retitled as the HPCAAC, in H.R. 1757, and are gratified that the information industry is listed among the interests to be represented. In light of recent history, however, Congress would be well advised to set a deadline — perhaps 90 days after enactment — for holding the first meeting of the Advisory Committee.

Second, in light of the increased and entirely appropriate emphasis on private sector roles in H.R. 1757, we suggest that the HPCAAC charter should include one additional mandate: to assess whether activities under the Program and the Plan are advancing the goal of promoting competitive private sector provision of all products and services with which the Program and Plan are concerned. While this goal may be more long-range in some areas than in others, it should be a lodestar for all activities under the amended HPCA, and the Advisory Committee is well suited to evaluate whether it is being followed.

Finally, the proposed revision of section 102 of the HPCA raises some questions, including the following:

> **** In section 102(d), is the prohibition on use of the test bed networks for any services that could be provided satisfactorily over privately operated commercial networks intended to create an Acceptable Use Policy (AUP) that bars commercial services from the test beds? If so, should it be coupled with a commitment that other networks, even if they receive some level of federal assistance, should be kept AUP-free?**

** Why was the mandate to encourage access to commercial information services for users omitted when existing section 102(e) was revised as proposed section 102(f)? Although this section now applies to users of the Internet, rather than users of the NREN, any federal mandate to promote information services accessible over Internet should include helping Internet users access commercial services.

** What are the consequences of the new focus of HPCA activities on Internet? Does the focus on a particular set of networks, even one as expansively defined as Internet, risk neglect of other aspects of the information infrastructure that can make an important contribution to the goals of the legislation?

CONCLUSION

Mr. Chairman, I greatly appreciate the opportunity to offer these comments on behalf of the Information Industry Association. IIA commends you for your leadership on this important initiative, and looks forward to working with you and the other members of the subcommittee to improve and refine H.R. 1757.

Attachment: IIA Telecommunications Objectives
and Implementation Principles

Information Industry Association

TELECOMMUNICATIONS INFRASTRUCTURE OBJECTIVES AND IMPLEMENTATION PRINCIPLES

April 1993

INTRODUCTION

Technological advancements, desires for improved economic development, demands of the "Information Age," and increasing foreign competition have heightened concerns about future development in the United States' telecommunications infrastructure. The result: a national debate on improving and modernizing the telecommunications infrastructure.

International, national and state level deliberations about telecommunications infrastructure are important to IIA members. IIA has refined and expanded its positions regarding telecommunications infrastructure development and now is prepared to be an active participant in telecommunications infrastructure discussions wherever they occur.

This paper identifies IIA positions on the telecommunications infrastructure necessary to deliver electronic information and services. It is designed, in part, to provide input to government policymakers and other entities involved in development of policies affecting that infrastructure.(*)

The recommended policy objectives and implementation principles are listed on the next page. The remainder of this paper is intended to support the meaning of each position.

(*)This position paper does not address policies on privacy, security, protection of copyright and access to government data.

POLICY OBJECTIVES

- **Market forces are the preferred means** of determining telecommunications applications and services, and thus, the development of telecommunications infrastructure.

- **As telecommunications markets continue to evolve** from a regulated monopoly to a competitive regime, the role of governments should be to promote competition while protecting the public interest where competitive market forces are not yet fully operative.

IMPLEMENTATION PRINCIPLES

- **Telecommunications infrastructure evolution**, driven primarily by competitive market forces, is the ultimate goal. Where there is competition, market forces should determine the services offered. However, IIA recognizes that for the foreseeable future, noncompetitive, i.e., regulated, environments may continue to exist.

- **Governments' role in the development of the telecommunications infrastructure** should promote competition within the private sector as the best means of achieving rapid and broad-based evolution of a national telecommunications network. - In assuring the public interest, governments should monitor regulated telecommunications infrastructure development including factors related to service availability; performance reliability and quality; maintenance of reasonable rates; and the extent and appropriateness of regulation.

- **Rates for necessary services that are not subject to competition** should be cost-based, with appropriate incentives to control costs and encourage improvements in basic services as part of telecommunications infrastructure development.

- **Subsidies undermine competitive markets,** therefore their use should be minimized. To the extent governments determine subsidies are necessary, they should be targeted clearly to end-users to achieve specific goals and their purpose and administration must be reassessed continually.

- **Worldwide public policies should be pursued** which 1) promote open standards and interfaces; 2) promote high quality and availability of the telecommunications infrastructure; and 3) assure equal availability of access for all users to the underlying network capabilities and support systems.

BACKGROUND

The National Telecommunications and Information Administration (NTIA) has defined the information infrastructure as "all the facilities and instrumentalities engaged in delivering and disseminating information throughout the nation." This paper focuses solely on the telecommunications components of the information infrastructure associated with the delivery of electronic information services.

Today's U.S. telecommunications infrastructure largely has been achieved through a national policy as set forth in the Communications Act of 1934. The purpose of the Act was "... to make available, so far as possible, to all people of the United States a rapid, efficient, nationwide and worldwide wire and radio communication service with adequate facilities at reasonable charges." Through the years, these objectives have centered on the concept of "universal service" which largely has remained unaltered in law, and as a commitment of policymakers. Indeed, it is generally accepted that the U.S. has achieved its original universal service objectives to provide every home with access to a telephone at reasonable rates.(*)

The objectives of universal service were attained over a 50-year period and in a monopolistic environment involving substantial regulation and subsidy arrangements. IIA believes that the emerging competitive environment in the telecommunications industry can strengthen the goal of universal service. IIA further recognizes that decision makers must reassess the policies and procedures used to implement that goal in the context of new technologies and market structures.

Today, competition has yielded a wide array of new products and services which were unimaginable only a few years ago. As technology and competition progress, consumers will choose freely the products and services they want, and from which providers they want to purchase. Increased competition — already evident in many markets integral to telecommunications infrastructure development — is arguably the most dramatic new paradigm for policymakers to consider.

Competition is a highly desirable aspect of new telecommunications infrastructure development. New national and state policy objectives must be considered in the light of evolving marketplace realities. Policies must be reshaped to address the challenges and promises of today's national and international competitive environments. IIA believes governments will continue to have important roles and responsibilities in telecommunications infrastructure development as a means of ensuring fair competition and protecting the public interest.

(*) FCC Monitoring Report (over 95 percent of U.S. households have access to a telephone).

POLICY OBJECTIVES

- **Market forces are the preferred means of determining telecommunications applications and services, and thus, the development of telecommunications infrastructure.**

  IIA supports policies which encourage competition and market driven solutions for future telecommunication needs. This means that public policies should encourage participants to fill market needs based on competition and market forces. This direction will afford greater opportunities to American businesses and consumers.

  The U.S. telecommunications industry currently is in the midst of a transition to an open market where buyers and sellers decide which products are offered and at what prices. In this mode, the U.S. already has achieved the most open telecommunications market in the world — with rapidly expanding choices in new technologies and services. For this transition to be fully beneficial, competition must continue to be given every opportunity to succeed.

- **As telecommunications markets continue to evolve from a regulated monopoly to a competitive regime, the role of governments should be to promote competition while protecting the public interest where competitive market forces are not yet fully operative.**

  The public's needs have changed since the 1934 Communications Act and subsequent adoption of universal service objectives. Electronic communications have evolved dramatically during the latter part of this century. The telecommunications infrastructure has become one of the fundamental elements of commerce by providing transmission facilities increasingly used to distribute products and services. The expanding and changing nature of the telecommunications infrastructure presents policymakers with new and different public interest issues to consider and accommodate in the context of changing technologies and market structures.

  Governments must review and evaluate imbedded policies and procedures to determine if they are in harmony with these new public interest issues. Newly developed policies should protect full, fair and open competition where it exists. Further, these policies should promote and encourage competition where it has not yet developed.

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IMPLEMENTATION PRINCIPLES

- **Telecommunications infrastructure evolution, driven primarily by competitive market forces, is the ultimate goal. Where there is competition, market forces should determine the services offered. However, IIA recognizes that for the foreseeable future, noncompetitive, i.e., regulated, environments may continue to exist.**

  Competition thrives when policies and rules do not favor particular entities, groups or interests, and when access to telecommunications infrastructure is equally available to all participants. Competitors must study carefully markets to identify product innovations and efficiencies which help achieve competitive advantages, fostering a robust marketplace.

  Competition produces an atmosphere where customers are able to choose a variety of services from multiple suppliers and at fair prices. Governments should ensure that rules, policies and procedures encourage and support evolution to fully competitive environments.

- **Governments' role in the development of the telecommunications infrastructure should serve to promote competition within the private sector as the best means of achieving rapid and broad-based evolution of a national telecommunications network.**

  IIA believes governments should seek to establish policies and rules which promote and maintain fair and open competition. In promoting these public policy goals, government, as the "agent of the people," may play an important role in participating in research and development by setting challenging objectives and encouraging related, pre-competitive experimentation in critical, new technologies. IIA recognizes that governments may support research when private competitive entities are unable to fully justify financial risks inherent in research of unknown value. However, IIA does not support government development or operation of telecommunications infrastructure or other resources used for commercial applications which could be supplied through competitive telecommunications infrastructure solutions. Simply put, governments should not perform functions or provide services that can be achieved through the competitive private sector.

- **In assuring the public interest, governments should monitor regulated telecommunications infrastructure development including factors related to service availability; performance reliability and quality; maintenance of reasonable rates; and the extent and appropriateness of regulation.**

  Governments' primary concern must be the protection of the public interest, which is best served when open competition flourishes. They must encourage competitive services by maintaining balance and fairness. Governments must allow competitive market forces, where they exist, to determine which services will be successful. Open markets should be allowed first to demonstrate which services have value, and only when it is clear that competition absolutely cannot meet the public's needs adequately should regulation be considered.

  Where competition has not been adequately developed, IIA recognizes the need for government assistance and/or regulation. Government action should be focused on boosting market development through availability of essential services and setting standards for minimum service availability and reliability among providers. If monopoly franchises continue to be necessary, IIA recommends strong government oversight and control to ensure equal access to basic network capabilities, service quality and reasonable rates.

- **Rates for necessary services that are not subject to competition should be cost-based, with appropriate incentives to control costs and encourage improvements in basic services as part of telecommunications infrastructure development.**

  In areas where essential and basic telecommunications services are provided to users, but are offered without competition, it is appropriate for regulators to monitor and control basic service rates to ensure that they are reasonable. In regulated markets, incentives for providers to control their costs, as well as to invest in new technologies also are appropriate, with the goal of reducing overall costs and providing expanded telecommunications infrastructure capabilities similar to those found in competitive markets.

  In the context of governments' encouragement of competition, it also may become appropriate for regulators to protect ratepayer investments and establish pricing policies and procedures to guarantee fair treatment of all competitors.

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- **Subsidies undermine competitive markets: therefore their use should be minimized. To the extent governments determine subsidies are necessary, they should be targeted clearly to end-users to achieve specific goals and their purpose and administration must be reassessed continually.**

Subsidies create artificial demand, discourage competitors from offering new solutions to subsidized services, and create pricing anomalies between technically similar or identical services.

In the event subsidies are found to be necessary to support important public policy goals, they must be administered by capable, neutral party(ies), i.e., not solely by service providers. Further, effective administration of subsidies should achieve the following:

a) The purpose of any subsidy should be defined specifically with respect to its intended use in supporting public policy, and should be transparent in its administration to the intended recipient(s) and payer(s);

b) Subsidy programs should have mechanisms which limit their financial impact and duration; and

c) The burdens and benefits of any subsidy program must be equitably and fairly distributed among all participants. No affected providers should be unreasonably advantaged or disadvantaged by the subsidy program.

- **Worldwide public policies should be pursued which 1) promote open standards and interfaces; 2) promote high quality and availability of the telecommunications infrastructure; and 3) assure equal availability of access for all users to the underlying network capabilities and support systems.**

Access to open, standard interfaces for network and other system functions will have greater importance and create more value as information products and services are designed and offered to meet the needs of "untapped" consumer markets. Currently, such needs include requirements for narrowband services, broadband/multimedia services, Personal Communications Services (PCS), cable television (CATV), video dialtone, etc. Each of these services has specific, and often unique, technical requirements — such as bandwidth, delay and performance — which may require unique, but open, interfaces.

Public policy should promote competition which fosters standards that ensure service quality and availability of the telecommunications infrastructure to meet the public interest. Recommendation or facilitation of basic standards parameters should be developed in an open forum consisting of all interested parties, including governments, carriers, users, etc. The use of standard and effective open interfaces should minimize the burden on entrepreneurs and other users of the telecommunications infrastructure when expanding information services and products.

CONCLUSION

IIA supports policymakers who address issues surrounding the development of the telecommunications infrastructure. We commend leaders who demonstrate a willingness to help the information industry introduce domestic and international policies consistent with the positions stated above.

Information is the content of communication. As such, electronic information services have a tremendous dependence upon and interest in telecommunications infrastructure development. That development will help the United States to increase its global competitive capabilities. IIA strongly recommends continuing debate on, and early adoption of, the objectives and principles described above as a means to accelerate the development of the telecommunications information infrastructure.

Telecommunications infrastructure development will not be an easy task. It accompanies the evolution, in certain sectors, from highly regulated processes where governments set objectives for service availability and quality to an environment where competitive market forces determine services and features offered. In 1934, the United States had a national mandate to achieve universal service. Today, the transition to policies that rely on competition and open standards for network and service interoperability is highly desirable and supported by IIA.

The Information Industry Association, celebrating its 25th anniversary, represents some 500 companies involved in the generation, distribution and use of information products and services.

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Mr. **BOUCHER**. Thank you very much, Ms. Braddon.

And I would like to express the thanks of the subcommittee to all of the witnesses for their very helpful comments here today.

Let me start with a broad question to each of you, and that is, have we in this measure identified the proper kinds of applications of high speed networking that deserve Federal research support? Are there other kinds of applications that we ought to be considering? Another part of the question would be: have we allocated sufficient resources to achieve the goals we've specified in terms of developing these applications and do we have a fair allocation of those resources among the various applications that we are targeting?

And I'll call on whoever appears ready to answer. Ms. Stout, would you like to begin?

Ms. **STOUT**. Thank you.

You have a number of applications that you have identified. The problem within education is that our community has not had access to it, so it's very difficult to identify all the applications that we need. So that is hard for us to answer, but, yet, we know we can test and research that. We need help with connectivity, connections programs to really understand what happens to this social order of things when we go into an application such as this.

The other thing is we need to look at full motion—full interactive capability, multimedia capability, as we put this together. And my experience has been we have to go to the schools to really understand what their needs are and base that—not take technology and take it to the schools without assessing that first.

As far as the resources, I think if this is fully funded, it will certainly help. I'm looking back at the budget that we have within our State, and just to implement the network I spent 65 percent of the amount of money on training. And the other thing that's important to note there, it is not just training on how to use the hardware. That is only how to get into the door. The other type of training includes how do you use this technology, how is it different from the way we communicate today. If I send you an electronic mail message, which I would be delighted to be able to do so, how will you perceive that? The rules aren't the same. So we certainly need to understand those applications.

The third thing is how to integrate it within our current system. So those are three applications, three separate types of training applications.

Fair allocations—I think more money needs to be provided in connections to schools. We have an infrastructure problem. We have school classrooms without electrical outlets. So it's a major problem in those particular areas.

In phone lines, the average number of phone lines in an elementary classroom happens to be—or an elementary school happens to be two; in a junior high it's three; in a high school it's six. So we have an infrastructure problem there.

Mr. **BOUCHER**. Thank you very much.

Dr. Detmer?

Dr. **DETMER**. Yes, I think, as I said, I think you've done an extraordinary job of really covering the general scope. I really don't see any major gaps at all. I think there are some issues in the resource side in personnel training. We need more expertise in medical informatics, both I think—well, almost across the board, whether you're talking about the technology or its application side.

I think, if I might add also a point, I think that this is such a big enterprise that it will require tracking over time, and I just would like to agree with Ms. Braddon's point about the advisory committee. I think the importance of getting it up and running as soon as possible is helpful because you will, I believe, need that kind of input over time to track on these things.

Thank you.

Mr. BOUCHER. Well, I might just add to that that not only do we anticipate this advisory committee being appointed in a timely way, but the legislation itself requires periodic reports to the Congress on the steps that are taken to implement our goals and objectives, and a further recommendation on an ongoing basis to the Congress of changes in the law that we need to make in order to keep the program moving forward, to keep it modern, and make sure that new applications for the network get the research and development funding that they need and deserve.

Who else would like to comment? Mr. Masten?

Mr. MASTEN. If I might, I certainly second what has been said about the scope and inclusiveness of your planning. We are greatly heartened by it, and I think from our perspective the issues are ones of emphasis. Training is terribly important for us. Not only are we concerned about bringing the public along in their level of sophistication as potential users of the network, but our own professionals, our own librarians need that support as well. And that's costly and time-consuming and invaluable to get the value out of this infrastructure that we all want.

Secondly, I'd like to say that we think the way in which the applications are developed is important. In my written testimony I suggested that an attempt should be made to have as much cooperative work done between levels—local, regional, statewide, and Federal—in order to tap not only the experience of this development on all those levels, as institutions or regions have developed their ad hoc networks, but also because those people are on the ground. They're close to the users. They know what the users want and need, and I think that's absolutely critical to make sure that whatever the dollars are that can finally be appropriated, that they're used wisely.

And, finally, I'd like to suggest that in connection with the section on digital libraries, we certainly agree that the technical issues that are outlined in terms of the development of searching software, and so forth, are all critical. I do want to just repeat, though, I guess our concern that we not think of digital libraries as something that's sort of monolithic, housed under a mountain somewhere. There are digital resources scattered across the network now. They have taken their shape partly from the ways in which libraries and other educational bodies interact already in terms of sharing burdens, and it would be terrible to waste that local intelligence as to how best to apply resources. If the support of the growth of digital libraries can pay attention to this point of building on what's already there, of not trying to centralize a digital library, which is sort of counter to the whole notion of the distribution of information across a network, we think that's a point well worth considering.

Mr. BOUCHER. All right. Dr. Massengale?

Dr. MASSENGALE. Chairman Boucher, I'd just like to make a couple of additional points. First, when we're speaking of networks, to me this is more than a connection. It involves training. It involves people. I think as far as the resources go, how far and how fast we can go will depend to some extent on the resources that are made available.

And as far as application, what is in the bill I think is a good start. We must remember that this is still a growing field, and it's one that's expanding rapidly. And, as a result, I think we don't want to restrict it too much, be too restrictive at an early stage.

Mr. BOUCHER. Okay. Ms. Braddon?

Ms. BRADDON. I would agree with the folks who have come before me. I think that the applications that you've identified in this bill are certainly at the front of the list to go after. Of course, as I mentioned in my statement, we would also like to see copyright management added to each of the applications and the R&D effort.

Whether the appropriations that you're asking for come through, we certainly hope so. Then, again, a lot depends on how well the money is spent once it's appropriated. It could be spent where competition is fostered and you have a wide, diverse source of information or it could be spent in a way where you end up with one source, and that's not in anyone's best interest.

Mr. BOUCHER. Well, thank you for that additional information.

Let me begin some more specific questioning with you, Ms. Braddon. You have mentioned the concern about copyright protection when the network is more ubiquitous than it is today and when it is accessible to a broad number of people and a lot of data of different kinds is being transmitted over it. And I certainly acknowledge that that is a concern.

I don't know whether this is the right place to address that or whether it ought to be done in a more generic way as an amendment to the copyright law at some future point. And this is where I need some guidance from you.

We have in the bill at the moment a provision that is targeted toward allocating research funds for network security, and that, of course, would take a number of different forms. It was our intention within the scope of this to ensure that intellectual property rights are also protected. That's a very vital part of network security and maybe some mention of that should go into this section. Beyond simply mentioning that, however, do you have any specific recommendations for us as to what we ought to do in terms of targeting research funding in that specific area?

Ms. BRADDON. I guess you've just identified one of the key areas where we thought that it might belong since security and integrity of the data that you're going after are close cousins to intellectual property.

In terms of specific recommendations, what we'd like to do is provide you with some specific language following the hearing.

Mr. BOUCHER. All right, we'd welcome that. Thank you very much.

[The information follows:]

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May 11, 1993

The Honorable Rick Boucher, Chairman
Subcommittee on Science
Committee on Science, Space and Technology
U. S. House of Representatives
2319 Rayburn House Office Building
Washington, DC 20515

Dear Mr. Chairman:

On behalf of the Information Industry Association (IIA), I write to thank you for inviting IIA to present testimony before your subcommittee last Thursday on the High Performance Computing and High Speed Networking Applications Act of 1993, H.R. 1757. I hope that the testimony of Cynthia Braddon of McGraw-Hill, Inc., chair of IIA's Public Policy and Government Relations Council, was useful to you and the other members of the subcommittee.

In my conversation with him immediately after the hearing, Dr. James Wilson of the subcommittee staff urged IIA to submit proposals for amendments to H.R. 1757, based upon our testimony, as soon as possible. In response to this request, we have prepared the attached five proposed amendments for your consideration. In drafting these amendments, we have taken a minimalist approach, and propose only those changes most essential to the concerns raised in our testimony. We are continuing to study the bill, especially the proposed amendments to section 102 of the High Performance Computing Act of 1991 (HPCA), and may have further suggestions to offer.

The five suggested amendments can be briefly summarized as follows (page references are to H.R. 1757 as introduced):

(1) Section 306 (Network Access) (pp. 10-11): Under this amendment, authorized training programs under the plan would include education in respect for privacy, security, and intellectual property rights in the Internet milieu. As noted in IIA's testimony, influencing the "Internet culture" on these issues may be as important as technological breakthroughs in developing an attractive environment for providing information services. This amendment also directs OSTP to report to Congress on recommendations for programs to protect security, privacy and intellectual property rights, in partial replacement of the OSTP reporting requirement under current section 102(g) of the HPCA.

(2) Section 307 (Research in Support of Applications) (p. 12): This amendment expands the mandate for research on security, privacy and data integrity to specify the closely related field of intellectual property protection and management. This topic is so critical to the success of network-delivered information services that it deserves specific mention.

(3) Section 310 (Applications for Libraries) (p. 21): This amendment recognizes that resolving copyright management issues is an essential step in developing digital libraries. While it is important to incorporate this focus into several of the specific project areas authorized by section 310(b), especially the development of high-performance digitization technology under section 310(b)(2), we suggest that it be specified as a separate project area applicable to all aspects of digital library technology development. The amendment also clarifies that the adoption of common standards and formats would be on a voluntary basis.

(4) Section 311 (Applications for Government Information) (pp. 23-24): Strong policy direction is the key for a successful program in this area. IIA's minimalist approach simply calls for the President to designate a lead agency (H.R. 1757 already specifies lead agencies for most of the other programs it authorizes) with a mandate to set policy guidelines that will promote a competitive marketplace in information services based on government information. The terse policy guidance given here reflects the consensus on this issue, as exemplified in legislation passed by the House in 1990, without going into unneeded detail. The amendment also clarifies that if state and local government information is included in section 311 projects, it, like the corresponding federal data, should be free of government copyright claims.

(5) HPCA Section 101(b) (Advisory Committee) (p. 25): This amendment directs the HPCAAC to report on the impact of HPCA activities on promotion of competition, and sets a 90-day deadline for establishing the advisory committee and getting it to work. As you know, the previous Administration mooted this key mechanism for public input by failing to appoint any advisory committee members.

IIA would welcome the opportunity to discuss these suggested amendments with you at your earliest convenience. I will follow up with your staff to schedule an appointment for such a discussion.

Thank you once again for your invitation to testify, and thank you in advance for your consideration of these suggested amendments to H.R. 1757.

Sincerely yours,

Steven J. Metalitz
Vice President and
General Counsel

encl

Mr. BOUCHER. Dr. Massengale, you mentioned in your comments the concerns that have arisen in the education community, the research community generally, about the transition that is presently underway which might, in fact, be accelerated to some extent if our provision passes. From the publicly-supported NSFnet backbone, which is generally accessible to the research and education community without charge today, to an environment where it is expected that that traffic which can travel on a commercial network and where the speed of the commercial network is adequate to transport it, would, in fact, travel through that commercial connection. And the NSFnet would then be reserved for that kind of traffic that requires the higher speeds that only the NSFnet can make available and, by extension, what the NREN itself will make available when it becomes more operational.

Now I know that the community is somewhat concerned about that. A corollary to our provision which essentially would say that those commercial connections would have to be purchased where they can be purchased, is that the NSF would be providing support of a financial nature to the research and education community to make sure that those commercial connections are affordable and that people who need access to the network, to the Internet, for their research and education purposes can still obtain it.

It is a different way than that connectivity as assured by the government today, but one that, assuming the effectiveness of that program of supplements, should be, nonetheless, as effective. Is there any general disagreement with that trend that we move more toward that regime as opposed to the current way of doing business? And do you think that that trend generally is positive?

Dr. MASSENGALE. Chairman Boucher, first let me say that I think that the partnership which you referred to here is important and essential for us to function effectively and efficiently on behalf of all of our citizens, but I think the key thing—and you've touched on this—in developing a good transition plan is to develop one that provides access and affordability. To me, those are two key issues, and, as a result, there are some other issues involved, but I think we need to have a timeframe and a plan worked out where these are in place before we make that transition. I think we expect the commercial networks to handle those that they can afford to handle. And, to me, this is something we need to work together on rather than being in competition for.

Mr. BOUCHER. Well, I agree there shouldn't be any competition for it. As you indicated in your remarks, EDUCOM is planning to make some recommendations to us with regard to how we might assure that transition in a somewhat smoother way, and we'll look forward to getting those comments.

Dr. MASSENGALE. Thank you.

[The information follows:]

EDUCOM

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May 6, 1993

Mr. Rick Boucher
Chairman, Subcommittee on Science
United States House of Representatives
Washington, DC 20515

Dear Chairman Boucher:

I am enclosing a proposed revision to the current draft of HR1757, covering the issues we recently discussed in connection with Section 102(d) and the presentation of President Massengale at today's hearing. The intent of the attached revised language is to ensure that the termination of direct federal support for a developmental or pre-commercial service on the Internet for research and education users does not result in loss of service or the offering of service at unreasonable rates.

We believe this revised provision is responsive to the desire of both the federal establishment, as well as its public and private sector networking partners, to successfully transfer network services and applications developed with federal support on the Internet to commercial sources. At the same time, it recognizes that the technology development process is seldom totally predictable, and that there are classes of publicly needed network services, such as rural health care, for which a viable private sector market may never emerge. It also protects the interest of the government in seeing that public tax dollars are expended in the most economical way possible.

I would like to take this opportunity to express a more general concern about our current situation and your proposed legislation.

First, delays in issuing the solicitation for NSFNET, coupled to the rapid growth of the Internet in general and NSFNET in particular, have created an unstable situation. The prospect of making large and fundamental changes to the economic structure of NSFNET at the same time that major operational and technology changes are made, and the members of a new public-private partnership are selected, is an undertaking which will stretch the resources of the research and networking community to the limit. The legitimate concerns of those in the community with responsibility for continuity of Internet services to faculty and students have not been diminished by the lack of any written transition planning information from NSF. Your personal interest in ensuring that the forthcoming major changes are dealt with in a timely and professional manner would be greatly appreciated.

Second, as we discussed, the shift in emphasis of the federal NREN program in the direction of applications is entirely appropriate and will be of great benefit to research and education. However, there must be adequate attention given to buttressing the entire network structure while the applications work goes forward. In other words, as we broaden the base of connected users, and deepen the range of applications supported on the network, we must be careful not to move so rapidly that we fail to meet necessary stability and quality of service requirements. In this connection, I believe that the eighteen month limit on the provision of testbed services, which are redefined in your bill to include both connections and specific community support in addition to the purely experimental work included in the original bill, needs careful consideration. My suggestion would be that a date beyond the conclusion of the forthcoming changes in NSFNET be selected in consultation with the appropriate officials from the Executive Branch.

I hope you find these comments useful. My staff and I look forward to working with the committee toward successful passage of this important legislation.

Sincerely,

Robert C. Heterick, Jr.
President

Enclosure

cc: Dr. Wilson
Dr. Nelson
Dr. Wolff

Enclosure to R.C. Heterick, Jr. ltr
May 6, 1993

Existing text from HR1757:

"Section 102(d) - RESTRICTION ON USE OF TESTBED NETWORKS.

(1) The testbed networks shall not be used to provide services that could otherwise be provided satisfactorily using privately operated commercial networks.

(2) This subsection shall take effect 18 months after the date of enactment of the High Performance Computing and High Speed Networking Applications Act of 1993."

Proposed new text:

Section 102(d) - RESTRICTION ON USE OF TESTBED NETWORKS.

(1) Subject to the following conditions, the testbed networks shall not be used to provide services that could otherwise be provided satisfactorily from commercial sources:

(a) access to the commercial network service(s) must be available in at least 90% of the locations at which access to the testbed network service(s) is provided;

(b) charges for use of the commercial network service(s) may not exceed the greater of (i) the charges paid by the government for the equivalent testbed service(s), or (ii) the lowest price charged by commercial network service(s) providers to any other client.

(2) This subsection shall take effect 18 months after the date of enactment of the High Performance Computing and High Speed Networking Applications Act of 1993."

Mr. BOUCHER. Ms. Stout, as the head of an education network in the State of Texas, you may have some concerns about that same issue, and if you do, this would be a good time to express them.

Ms. STOUT. Thank you, Chairman Boucher.

I do have real concerns about that. After having worked with our State network and watching the use of a commercial network where you could not predict the charge, I saw a limitation of use. Teachers were not given access to the network; students were not given access to the network unless it was a flat rate, a predictable cost.

And under the current condition that we're using the network right now, a teacher in Texas is able to go to the NASA space link or check the underground weather at the University of Michigan without additional costs. When you put those costs on there, they can't access. That's going to preclude their use. I don't—I think it does take a close partnership, but it's with real concern that I see this trend going.

What I have is—I feel like I've got my finger in a dike because we have one educator signing for TENET every 30 minutes. They, the teachers, feel a sense of entitlement to this. Now if we were to say you have to have an additional fee for this, I don't think they can use it and they certainly could not allow children to use it. So there's grave concern.

Mr. BOUCHER. Okay. On the general issue of providing supplements directly to the research and educational community, perhaps through the regional networks as the recipient agency, that would assure the ability to purchase commercial connections to the Internet, do you have any comment on that general trend, which is the direction in which the National Science Foundation is moving even today?

Ms. STOUT. Well, of course, in our State we have—our State has a regional network, and I think we don't—we haven't had Federal funding for that network, but I feel like that is the proper application to get those connections.

Mr. BOUCHER. Your research and education users, however, when they obtain access to the Internet——

Ms. STOUT. Right.

Mr. BOUCHER [continuing]. Are doing so, essentially, through a Federal subsidy because of the NSF operation of NSFnet. And what the NSF is proposing, through its recompetition for the management of the NSFnet backbone, is that those who can purchase commercial connections do so, even though they may be research and education users. And in order to make that affordable, in the absence of NSFnet subsidy for operation of the backbone for those same users, the NSF would simply provide the subsidies directly. Now that's the trend in which they're moving.

Do you have any comment on that general direction?

Ms. STOUT. I think that we have to have a subsidy provided because we need a public education network.

Mr. BOUCHER. In one form or the other, you need the subsidy?

Ms. STOUT. In one form or the other, that's correct.

Mr. BOUCHER. And it needs to be workable; that's your message?

Ms. STOUT. Absolutely.

Mr. **Boucher**. All right. Mr. Masten?

Mr. **Masten**. I just wanted to add a comment, which is I think for all of us who are developing services in these areas, it's not always possible to anticipate at the beginning what the volume of use will be, and part of the economic issue here is the band width of the connection and what volume you're going to require in order to serve your users.

Libraries have a tradition of welcoming everybody who can come in when the door is open, and if we get too good at what we're doing, we could find ourselves buried under the cost of connection, because to the extent that it's sensitive to volume, that's a real issue for us. So I'd just like to mention that as a caution, that paying attention and even considering ceilings or caps or something like that might be important as a way to provide some planning ability on the part of local entities, knowing that if they succeed, they won't be penalized.

Mr. **Boucher**. While you're speaking, let me ask you a question about the extent to which libraries are placing in digital form their printed materials today. You mentioned that it is happening in some places.

One of the concerns that I have—and we direct, in fact, research funding in the legislation to address this—is that as the information is being stored in digital form, the formats in which it is being stored may not be entirely compatible between one library and another, and if you have persons with PCs located at a variety of places around the country, they may not be able, once the network is fully operational, to access those digital libraries with a common set of commands.

Do you have any comment on the extent to which there's some effort now to assure compatibility and how much of a task is it going to be for the Federal Government to encourage that common set of standards and protocols?

Mr. **Masten**. Well, I think there is number of issues that you've raised there. The library community, speaking both in the context of the American Library Association and also the Association of Research Libraries, and the research arm which is the Research Libraries Information Network, based in Palo Alto, all of these bodies have over time and out of self-interest developed a great deal of—consensus isn't the word yet, but attention to the problems of compatibility.

I think—and I'm not a technician, so I'm not going to speak with too much authority on this—that the problems of compatibility when you find your way into another library across the network, you certainly are going to have to deal with the searching routines, and so forth, that are available, say, within a campus when you arrive there through the Internet. There is a problem of so-called normalizing the feedback that the user gets, so that he or she can understand and be familiar and comfortable with those search requirements. You know, at the moment it almost requires a guidebook for the user moving through the Internet to know what routines they're going to have to follow as they move from location to location.

But I don't think those are insurmountable at all, and I don't know, actually, that a governmental approach is the final answer to that. Those communities have tried to develop protocols themselves. And I think in some ways the technical issues of transmission standards, and so on, have been resolved the most easily.

I'm not sure if I'm answering all of the parts of your question. You also began by saying that you were interested in the way in which libraries have been developing digital materials, and certainly one of the potential obstacles to them moving across the Internet or its successor are these issues of compatibility, but I think they're resolvable.

Mr. BOUCHER. Well, I hope they're resolvable. I'm just wondering how big a task it's going to be to resolve them and to what extent the government's role should be directed toward that.

Dr. Detmer, your comment, please?

Dr. DETMER. I think this is important in medical informatics. I can't speak—and I'm not an expert in the details, but I think the difficulty up until recently has been user-friendliness from the human interface side, but what I think you're speaking to is the user friendliness from the machine interface side, and that, I think, is a fairly complicated issue, but extraordinarily important, and this issue of transparency and compatibility, so that you can have, essentially, the equipment talk to itself as it needs to is a very important matter. But I'm confident that an advisory group would have expertise, certainly, that could obviously track on that as well.

Mr. BOUCHER. What I'm really looking at, maybe something a little simpler, and that is just the notion that we will store the data in formats that are compatible with the formats in which other data is stored by other libraries around the country. So that a user will, in fact, be able to dial up any library in the country, browse through the electronic index, retrieve whatever document he is looking for, maybe print it out there in his living room on his laser printer, and be able to do that with a common set of commands with respect to any library whose files he's browsing through. It's really a——

Dr. DETMER. Well, part of the——

Mr. BOUCHER. I'm sorry.

Dr. DETMER. Well, excuse me. Had you finished? I'm sorry.

I think part of the challenge on that is if you make the standards too tight and too rigid, then you lose some of the flexibilities of being able to interface with it, too, and that's part of the tension that is in some of this business of how do you set the formats and the standards, and do they then become actually a tension against future progress and get in your way?

Mr. BOUCHER. That's a very fair point.

Dr. Massengale?

Dr. MASSENGALE. Chairman Boucher, I'd like to indicate that within our national association that we have two groups. One is a commission, the Commission on Information Technologies, that's working on these very issues, copyright and intellectual property, as well as the things we've mentioned here. And, also, within the AAU organization, there's a special library committee headed up by Dr. Hannah Gray, who is the president of the University of Chicago, that's working on these very issues. And I think they'd be glad to offer specific suggestions later if you'd like for them to do that.

Mr. BOUCHER. Well, it would be extremely helpful. I'm not sure for purposes of passing this bill that we need to inquire into much greater detail about it. We have targeted this as an area where research and development funding is necessary. The specific use of that money would be directed by the advisory committee, as well as the other Federal agencies that participate in the research. And so there is plenty of opportunity to fine-tune the direction of that down the road.

I was just trying to get a general sense as to how significant that problem is, and I gather that it is one of sufficient significance that we need to target or direct research toward it.

Dr. MASSENGALE. Correct.

Mr. BOUCHER. Let me ask you another very broad question, and I ask this because I rather suspect that at some point early on in the process of passing this bill, perhaps as early as the markup in full committee, that the objection may be raised that we're spending over a period of years more than a billion dollars and that these are tough fiscal times and that perhaps this money should not be appropriated at all.

And so my question to you is this: if we do not target these research applications in terms of using the network for health care delivery, for digitizing and retrieving the information from libraries, of distance learning for educational purposes, of making available the vast stores of government information, which are the broad areas we've targeted here, is it likely that these applications will arise on their own within an acceptable period of time and that, without any government research and development funding targeted toward this, that Americans will enjoy the full use of the information superhighway that this legislation contemplates?

Mr. Massengale?

Dr. MASSENGALE. Mr. Chairman, I might respond to that initially. And I would simply say that I see this as investment in our future as a nation, because if we're going to compete worldwide as a society, I think we have to make investments in this type of technology.

The two areas, as you well know, that we now I think still lead the world in in terms of export-import relationship, one is high technology; the other is agriculture. And this is an area that I don't think we can afford to lose that leadership in, and we need to be pushing ahead and developing applications, as well as finding new research information and their applications to keep us competitive as a society, nation.

Mr. BOUCHER. And without the research funding that we're providing, it's unlikely that these applications would be made available any time that's within the acceptable future?

Dr. MASSENGALE. I think that's true. And, as well, it's a national problem. It's not a problem of any one institution or any one state.

Mr. BOUCHER. Okay, good. Mr. Masten?

Mr. MASTEN. I think we've been in an environment where institutions have tried to wrestle with these problems on their own and have made sort of limited adjustments and made efforts, as we have, for example, to develop a screen for our users that is a guide to 150 locations on the Internet and tells them a little bit what to do when they get there, but that's not a substitute for the kind of standard format that can be made available across the country and make the ease of use that much better for everybody.

I'd also like to say that we just all have a stake in information flow across the country. In our case, we are developing our science and economics library as a resource for both local and national economic development. We will have data about European and Pacific Rim markets that we think everyone should get a shot at. And anything that slows our ability to disseminate that information is simply a drag on our ultimate competitiveness. If we can't put that in the hands of entrepreneurs who want to explore those markets, we're hurting ourselves.

So we think that, as usual, both the way our economic and political systems work, getting information out is the way to make it work the best and most competitively.

Mr. **BOUCHER**. Okay, thank you very much.

Ms. Stout?

Ms. **STOUT**. I think one of the most important things we can do with this bill is think of it in terms of investment in our intellectual infrastructure. Without the stimulus of this bill, I doubt that we will have it developed for a K–12 education except in some isolated areas. So, to me, it's extremely important that we have the ability to be able to see this bill fully funded, and think of it more than distance learning, but learning in all aspects of education. So it's critical to the success of schools.

Mr. **BOUCHER**. All right. Dr. Detmer?

Dr. **DETMER**. Yes. In terms of competitiveness, I think, clearly, there's been a lot of attention given to how health care costs are affecting national competitiveness. Of technologies that really, I think, have promise to really enhance, bootstrap significant gains in productivity in the health care dollar, I don't see anything on the horizon that matches this with the possible exception of some of the things coming from human genome research.

But both of those issues are federally financed and will require it to possibly be able to get this done. The entire Nation, I believe, will ride from that, actually, internationally much better than they will possibly be able to without it.

Mr. **BOUCHER**. Ms. Stout, I have a question for you that sort of deals with the intramural competition between a couple of Federal agencies, but I need your guidance as to how we should resolve the dispute.

One of the recommendations is that the direct connections monies to link institutions of learning, local libraries, local governments to the Internet should be provided in a program administered by the NTIA, which is an agency within the Department of Commerce that heretofore, has made grants for public telecommunications, public broadcasting equipment and the like, and advises the Administration generally on communications policy. But they're saying that it ought to assume now—some parties say that it ought to assume now this broader role of providing the direct connections money for local schools, libraries, and local governments.

The other school of thought is that the National Science Foundation, given its past history and performance in terms of networking technologies and its experience in supporting the educational community generally, is the agency that should administer this particular program.

Now you've had a great deal of experience administering a network for educational purposes in the State of Texas. Do you have any guidance for us as to which of these agencies is better equipped to discharge that mission and where we might get the greater public benefit, depending on the choice we make?

Ms. STOUT. Chairman Boucher, I've looked at information and how we can disseminate the network and what agencies might play the best role. I have to really look very carefully at the National Science Foundation as being that agency. The reason for that is you can't just put money out there for infrastructure without training, without research, and without an understanding of what it's going to be used for. And I don't see that same track record with the Department of Commerce. I equate it to sort of like the shotgun effect: you throw it out there, but they don't connect anywhere.

I feel like, you know—understand, you have to understand the culture of schooling and appropriate applications, and I think that's why the National Science Foundation can play a critical role.

But I also must say we have to look at the other agencies to make sure that we're in partnership together. In our State we do have other State agencies that deal with telecommunications, but we selected the University of Texas, Office of Telecommunication Service, because they have a good understanding of the networking and what's required. So I really do have to go back and support the National Science Foundation because they understand the tooling and the whole process of what's involved in this.

And I'll give you a real quick statement. I will never forget the fear in one superintendent when he found out that his teachers received the information from the Texas Education Agency at the same time he did. It's the change in cultural order, and we have to understand how to handle this.

Mr. BOUCHER. Okay. Does anyone else want to comment on that specific question? Dr. Massengale, your experience would be welcome on that issue, if you'd care to share it with us.

Dr. MASSENGALE. Well, thank you, Chairman Boucher.

I would agree with what Ms. Stout said. I think the National Science Foundation does have a good track record of working with institutions and state agencies, and so forth, and I believe that record of experience is something we should build on.

Mr. BOUCHER. Okay, thank you.

Dr. Detmer, I have one final question, and I'll ask that of you. You mentioned in your testimony the Computer-Based Patient Record Institute——

Dr. DETMER. Right.

Mr. BOUCHER [continuing]. And we're not familiar with that. I wonder if you could tell us what it is and how it functions and what role you would see that institute playing, if any, in the telecommunications future with regard to health care delivery, and to the extent that we should be aware of its function and incorporate that in some way either in the legislation or the planning process, your advice would be welcome.

Dr. DETMER. Thank you very much, Chairman Boucher.

The CPRI, the Computer-based Patient Record Institute, was recommended, actually, in the Institute of Medicine report. It didn't exist at that point. It was recommended that it be formed because the feeling was if this technology were to be developed, it would need some organization to track it, a public-private partnership organization to look at this over a 10-year period as this developed, to look at its coordination, to make sure that the players were talking to one another, that things weren't going off too much in any one direction without folks knowing about it, in a sense, an advisory committee for this initiative, much like you're talking about for the high performance initiative.

The American Medical Association, the American Hospital Association, the American Nursing Association, the Chamber of Commerce, the American Health Information Management Association, a variety of those initially incorporated this entity. And since that time, a wide variety of educational institutions and others have come onboard with that.

The AHCPR on the Federal side, the National Library of Medicine, and some people in HCFA and DOD have had informal relationships to the CPRI, but there's not been an explicit link on the Federal side to this largely public entity at this—or private entity at this point.

I think that—that's where I think that, actually, if we could forge that partnership to track the pieces of this that relate to the computer-based record, it would be helpful. It's a fledgling organization, but it has the right players at the table. I think it is making progress, and certainly for that piece of it to see that coordination occur, I think is very important.

Mr. BOUCHER. Thank you for that explanation.

Ms. Braddon in her testimony talked generally about the integrity of intellectual property being maintained as data flows on a high speed network. Do you have any similar concerns about the ownership interests in patient records? Is this something that ought to be addressed from the governmental perspective?

Dr. DETMER. That clearly is a part of the agenda that was laid out by the IOM report for exactly that reason; there are a lot of issues in there, absolutely.

Mr. BOUCHER. Are there recommendations to us, perhaps not for the purview of this particular committee, since we're focused mostly on research, but are there recommendations to us as a Congress as to how we might appropriately address those concerns? Think about it, and if you have some, send them my way.

Dr. DETMER. All right. Okay, I'll be happy to send something along.

Mr. BOUCHER. I'm burdened with the responsibility of serving on the committee that has intellectual property jurisdiction as well. So we could maybe take that up in a different forum.

I want to express the thanks of the subcommittee for their very helpful testimony here today and their patience in sitting through a series of rollcall votes on the floor. Your information will be reviewed very carefully by the members and staff, and as we make refinements to this measure, we will certainly take your recommendations into account. And we may propound additional questions to you. So don't be surprised if you hear from us.

With the subcommittee's thanks, this panel is excused and this hearing is adjourned.

[Whereupon, at 3:36 p.m., the subcommittee adjourned, subject to the call of the Chair.]

H.R. 1757—HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993

TUESDAY, MAY 11, 1993

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Science,
Washington, DC.

The Subcommittee met, pursuant to call, at 9 a.m., in room 2318, Rayburn House Office Building, Hon. Rick Boucher (chairman of the subcommittee), presiding.

Mr. Boucher. The Subcommittee will come to order.

This morning, the Science Subcommittee continues its series of hearings on the High Performance Computing and High Speed Networking Applications Act of 1993, H.R. 1757. In addition, the Subcommittee will receive testimony today on the status of the implementation of the High Performance Computing Act of 1991. H.R. 1757 amends the 1991 Act to capture the promise of high performance computing and high speed networking for applications in health services, education and access to information stored in libraries and depositories maintained by the government.

The 1991 Act and H.R. 1757 support research, development and demonstration activities which are essential to achieve the administration's goal of creating information superhighways for the Nation. In particular, H.R. 1757 embodies the information infrastructure provisions of the President's technology plan released on February 22nd, and entitled "Technology for America's Economic Growth."

Our goal is to make new network technologies widely available to the public for such applications as routing medical information at unprecedented speeds, developing network-accessible digital libraries, linking schools and teachers for distance learning, and disseminating the vast stores of government information. The bill will foster the creation of a common set of standards and protocols for use of the high speed network, and will finance the development and demonstration of new networking technologies.

This is the third hearing in a series scheduled by this Subcommittee on the provisions of H.R. 1757. Previously we received testimony from the Director of the Office of Science and Technology Policy, from the computer, telecommunications and information industries, and from a wide range of users of network services. The main thrust of the testimony we have received to date from a wide array of witnesses has supported the need for the legislation and endorsed the major components of the bill.

The witnesses cited many examples of the potential benefits of high speed networks and made thoughtful recommendations on ways to improve certain provisions of the legislation. In addition, they underscored the importance of wide access for all segments of the population to the information superhighway, and the need for interconnection and interoperability of the many components which constitute the information infrastructure.

During today's hearing we invite our witnesses to comment on the provisions of the bill and to recommend additional purposes toward which Federal research efforts should be targeted. We also invite comments on the progress which has been made toward achieving the goals of the 1991 legislation, the High Performance Computing Act. Since the basic administrative structure for the High Performance Computing Program is the same as the applications program envisioned in H.R. 1757, we are particularly interested in learning about the lessons that have been—that are available to date, and whether changes are needed to the 1991 statute to improve the operation of the program. We also hope to learn more about the significance of the results that are emerging from the High Performance Computing Program.

I particularly want to extend the Subcommittee's welcome to Dr. Donald Lindberg, who is Director of the National Coordination Office for the High Performance Computing and Communications Program. The office he heads was established by OSTP partly in response to concerns from the R&D community about the need for tighter management control of and a single point of contact for information about the High Performance Computing Program. We are interested in reviewing the activities of his office and in obtaining the views of our other witnesses concerning its effectiveness.

We also extend the Subcommittee's welcome to our other witnesses who have traveled from various locations in the Nation to be present this morning. We will very much look forward to your testimony.

And pending that, I would like to recognize the gentleman from Texas, Mr. Johnson, for his opening comments.

Mr. JOHNSON. Thank you, sir. I appreciate that.

Mr. Chairman, I would like to thank and welcome our distinguished guests as well, and look forward to hearing their testimony on the benefits of the High Performance Computing Act.

I understand the objectives of this plan and realize it offers valuable services. But I question the role the government plays in its implementation, and there we may have some disagreement.

The Federal Government has a $4 trillion debt, and with this in mind, is it wise for our government to provide a billion and a half in new funding for a program that has already been funded for 1.8 billion?

Last month, Dr. Gibbons, President Clinton's Director of the Office of Science and Technology Policy, came before this Committee to discuss this Act and how it was to be funded, and stated "One shouldn't just always go out and be looking for brand-new money because we are not going to find it." So where is this new money coming from?

Only two options seem appropriate: increasing the deficit or raising taxes on the American people, both of which I feel are wrong.

This measure also creates and expands our bureaucracy. Americans, especially in my district, want the Federal Government to shrink, not expand. They know that our continued economic recovery depends on private sector jobs, not a larger bureaucracy. And I think we can achieve what we want to achieve without involving the government to the degree that we are trying to do.

We have got to stop competing with the private sector, and I think this measure in its present form puts our government in direct competition with the private sector, and we ought to try to help private business, not hinder them.

And I think we are on the right track with this program, but I think the funding needs to be in question. I hope we can address these concerns during this series of hearings.

And I thank you, Mr. Chairman.

Mr. BOUCHER. Thank you very much, Mr. Johnson. And we will welcome the witnesses' response to the statements that you have made as well today.

We now will welcome our first panel of witnesses: Dr. Donald Lindberg, Director of the National Coordination Office for High Performance Computing and Communications and Director of the National Library of Medicine; Dr. Malvin H. Kalos, Director of the Cornell Theory Center in Ithaca, New York; Dr. Jeff Kalb, President and Chief Executive Officer of MasPar Computer Corporation; Dr. Edward Masi, President of Supercomputer Systems Division of the Intel Corporation; and substituting today for Dr. Edward Lazowska is Dr. Fred Weingarten, the Executive Director of the Computing Research Association; Dr. David K. Herron, Senior Research Scientist of Lilly Research Laboratories, and Mr. John Gage, Director of the Science Office for Sun Microsystems Laboratories, Inc.

Before turning to this panel of witnesses, I would like to recognize the gentlewoman from California, Ms. Eshoo, who has several comments to make, particularly, I think, with reference to some of the witnesses who are on our panel this morning.

Ms. ESHOO. Thank you, Mr. Chairman. And good morning everyone, and a special welcome to all of the distinguished doctors here on the panel. It almost seems as if we should be having a health care hearing with all the doctors that are here.

I would like to extend a special warm welcome to John Gage and to Jeff Kalb who come from my distinguished district, the 14th District in California, the home of Silicon Valley. You are very good to travel all this way and to enlighten us.

So those are my comments this morning, and I hope at some point you will address the comments of my distinguished colleague, the ranking Republican member of the panel, because I think that he raises very good points. But I also understand that what you are all here for is to forge an important partnership from where you are with the Federal Government being a leader, and also enabling what you all are here this morning to testify on and what you do with your professionalism at home.

So welcome, and it really is wonderful to see you here. Thank you.

Mr. BOUCHER. Thank you very much, Ms. Eshoo.

Without objection, the prepared statements of each of the witnesses will be made a part of the record, and we would welcome your oral summaries of those statements. And given the large number of witnesses we have this morning and some constraints on the Subcommittee's time, we would ask that your oral summaries be kept to approximately 5 minutes, so that we will have opportunities to inquire of you with respect to the matters you discuss.

Mr. Gage, if you are prepared, we will just commence from left to right across this panel, and we'll be pleased to hear from you.

STATEMENTS OF DR. DONALD LINDBERG, DIRECTOR, NATIONAL COORDINATION OFFICE FOR HPCC PROGRAM, AND DIRECTOR, NATIONAL LIBRARY OF MEDICINE, BETHESDA, MD; DR. MALVIN H. KALOS, DIRECTOR, CORNELL THEORY CENTER, ITHACA, NY; JEFF KALB, PRESIDENT AND CEO, MASPAR COMPUTER CORP., SUNNYVALE, CA; EDWARD MASI, PRESIDENT, SUPERCOMPUTER SYSTEM DIVISION, INTEL CORP., BEAVERTON, OR; DR. FRED WEINGARTEN, EXECUTIVE DIRECTOR, COMPUTING RESEARCH ASSOCIATION, SUBSTITUTING FOR DR. EDWARD LAZOWSKA, PROFESSOR OF COMPUTER SCIENCE AND ENGINEERING, UNIVERSITY OF WASHINGTON, SEATTLE, WA; DR. DAVID K. HERRON, SENIOR RESEARCH SCIENTIST, LILLY RESEARCH LABORATORIES, INDIANAPOLIS, IN; JOHN B. GAGE, DIRECTOR, SCIENCE OFFICE, SUN MICROSYSTEMS LABORATORIES, INC., MOUNTAIN VIEW, CA, ACCOMPANIED BY DR. WHITFIELD DIFFIE, DISTINGUISHED ENGINEER

Mr. GAGE. Yes. Thank you very much. It is a great pleasure to be here.

I noticed this morning—for those of us that have a memory about the role of this Committee in advancing United States science, there is some validation for the reason we are here. As the New York Times cites this morning in the "Science" section, "A supercomputer, a program running on a supercomputer has concluded that a major theory describing fundamental particles is probably correct." Now this refers to work done by Ken Wilson, and for those of you that remember, Dr. Wilson, Nobel Laureate—the United States Nobel Laureate—before this committee in 1983, I believe, said that what he needed more than anything else to advance science and physics in particular was adequate computational power, and that statement, that testimony led to the foundation of the computing company called Floating Point Systems, which grew, employed many people, and is now part of Cray Research.

It seems that quantum chromodynamics, an abstruse field of physics, generates jobs. We used Ken Wilson's testimony as evidence from the highest reaches of American science that there was a need for computational capability to be provided, not just to a few, but to many. And to that end, in the last decade, industry together with government has built a network that enables researchers at every level to take advantage of these very high speed computers, as well as take advantage of communication among scientists.

So we are here today to assert that in our particular instance a group of academic researchers are capable of beginning a company 10 years ago with zero dollars and today we are a company of $4 billion. So based on the efforts afforded by this Committee to provide computational power, very high speed computational power for research in advanced physics that turned into job creation. We went from zero people 10 years ago to 13,000. We are now the 130th largest corporation in the United States, and it's based entirely upon the provision of networking based on work by DARPA and the National Science Foundation that allows smart people to take their knowledge and convert it to jobs.

So we support, in general, all attempts to broaden the network; in particular, into the community colleges, into the K-to-12s, because there are smart kids everywhere that we need and that we need to hire.

You will find in our testimony today one aspect on a portion of the worldwide network, which is emphasized in the bill in the section on network security and privacy.

Ten years ago we did not have the ubiquitous network. Today, we are beginning. We have 15 million people—15 million people worldwide, growing at a rate of 15 percent a month, on the Internet. The reason for it is simple. There is knowledge, there is collaboration, and there is the generation of new wealth based upon communication of smart people on the network.

So, with that and with the incredible advances in the last year allowing digital interconnection into the home—that will be the provision, for example, with TCI announcing $2 billion investment in fiber bringing entertainment to the home, with Time-Warner investing in an Orlando experiment to bring video on demand—all of these, they may not seem to be the network, they are built upon the work and research done in the area of high speed computing and high speed computer communication.

To move a movie requires a speed that the scientists want to move data, so they each help the other. So the ubiquity brought by the application areas that will drive the United States economy in the next decade have one important aspect heretofore not sufficiently developed, and that is the area of security. I bring this up in particular in light of the White House announcement of the national security.

NSA together with FBI and NIST proposed a form of encryption to be used in computer communications. I am accompanied by Dr. Whitfield Diffie, the coinventor of public key encryption, and in our statement we point out that the necessity for secure communication, necessity for business, necessity for research requires a significant advance in general deployment and general advance in knowledge of encryption methods.

We discuss in our testimony the particular technology of the Clipper system and the skip-jump algorithm. We will leave to questions details about this, but I would like to point out that it's important to realize as the United States moves forward rapidly to provision of ubiquitous digital communication, which is made possible by you and by the Federal investment in the research and development of specific networking technology, as that advances the assumption of privacy, which we had until telegraphy, until we had until the telephone, goes away.

And since all communications are now possible to be listened to because all communications are electronic, for the United States as a whole we believe we need to put considerable emphasis, as is mentioned in the bill, on network security and privacy, and we endorse any expansion and coordination of research coming from NSA, from the National Weapons Laboratories, from the universities, from industry to further that end.

Thank you.

[The prepared statement of Mr. Gage follows:]

TESTIMONY TO THE

HOUSE SUBCOMMITTEE ON SCIENCE

MAY 11, 1993

The Impact of a Secret Cryptographic Standard on Encryption, Privacy, Law Enforcement and Technology

On Behalf of
Sun Microsystems, Inc.:

Whitfield Diffie
Distinguished Engineer

John Gage
Director, Science Office

I'd like to begin by expressing my thanks to Congressman Boucher, the other members of the committee, and the committee staff for giving us the opportunity to appear before the committee and express our views.

On Friday, the 16th of April, a sweeping new proposal for both the promotion and control of cryptography was made public on the front page of the New York Times and in press releases from the White House and other organizations.

This proposal was to adopt a new cryptographic system as a federal standard, but at the same time to keep the system's functioning secret. The standard would call for the use of a tamper resistant chip, called Clipper, and embody a 'back door' that will allow the government to decrypt the traffic for law enforcement and national security purposes.

So far, available information about the chip is minimal and to some extent contradictory, but the essence appears to be this: when a Clipper chip prepares to encrypt a message, it generates a short preliminary signal rather candidly entitled the Law Enforcement Exploitation Field. Before another Clipper chip will decrypt the message, this signal must be fed into it. The Law Enforcement Exploitation Field or LEEF is tied to the key in use and the two must match for decryption to be successful. The LEEF in turn, when decrypted by a government held key that is unique to the chip, will reveal the key used to encrypt the message.

The effect is very much like that of the little keyhole in the back of the combination locks used on the lockers of school children. The children open the locks with the combinations, which is supposed to keep the other children out, but the teachers can always look in the lockers by using the key.

In the month that has elapsed since the announcement, we have studied the Clipper chip proposal as carefully as the available information permits. We conclude that such a proposal is at best premature and at worst will have a damaging effect on both business security and civil rights without making any improvement in law enforcement.

To give you some idea of the importance of the issues this raises, I'd like to suggest that you think about what are the most essential security mechanisms in your daily life and work. I believe you will realize that the most important things any of you ever do by way of security have nothing to do with guards, fences, badges, or safes. Far and away the most important element of your security is that you recognize your family, your friends, and your colleagues. Probably second to that is that you sign your signature, which provides the people to whom you give letters, checks, or documents, with a way of proving to third parties that you have said or promised something. Finally you engage in private conversations, saying things to your loved ones, your friends, or your staff that you do not wish to be overheard by anyone else.

These three mechanisms lean heavily on the physical: face to face contact between people or the exchange of written messages. At this moment in history, however, we are transferring our medium of social interaction from the physical to the electronic at a pace limited only by the development of our technology. Many of us spend half the day on the telephone talking to people we may visit in person at most a few times a year and the other half exchanging electronic mail with people we never meet in person.

Communication security has traditionally been seen as an arcane security technology of real concern only to the military and perhaps the banks and oil companies. Viewed in light of the observations above, however, it is revealed as nothing less than the transplantation of fundamental social mechanisms from the world of face to face meetings and pen and ink communication into a world of electronic mail, video conferences, electronic funds transfers, electronic data interchange, and, in the not too distant future, digital money and electronic voting.

No right of private conversation was enumerated in the constitution. I don't suppose it occurred to anyone at the time that it could be prevented. Now, however, we are on the verge of a world in which electronic communication is both so good and so inexpensive that intimate business and personal relationships will flourish between parties who can at most occasionally afford the luxury of traveling to visit each other. If we do not accept the right of these people to protect the privacy of their communication, we take a long step in the direction of a world in which privacy will belong only to the rich.

The import of this is clear: the decisions we make about communication security today will determine the kind of society we live in tomorrow.

The objective of the administration's proposal can be simply stated: they want to provide a high level of security to their friends, while being sure that the equipment cannot be used to prevent them from spying on their enemies.

Within a command society like the military, a mechanism of this sort that allows soldiers' communications to be protected from the enemy, but not necessarily from the Inspector General, is an entirely natural objective. Its imposition on a free society, however, is quite another matter.

Let us begin by examining the monitoring requirement and ask both whether it is essential to future law enforcement and what measures would be required to make it work as planned.

Eavesdropping, as its name reminds us, is not a new phenomenon. But in spite of the fact that police and spies have been doing it for a long time, it has acquired a whole new dimension since the invention of the telegraph. Prior to electronic communication, it was a hit or miss affair. Postal services as we know them today are a fairly new phenomenon and messages were carried by a variety of couriers, travelers, and merchants. Sensitive messages in particular, did not necessarily go by standardized channels. Paul Revere, who is generally remembered for only one short ride, was the American Revolution's courier, traveling routinely from Boston to Philadelphia with his saddle bags full of political broadsides.

Even when a letter was intercepted, opened, and read, there was no guarantee, despite some people's great skill with flaps and seals, that the victim would not notice the intrusion.

The development of the telephone, telegraph, and radio have given the spies a systematic way of intercepting messages. The telephone provides a means of communication so effective and convenient that even people who are aware of the danger routinely put aside their caution and use it to convey sensitive information.
Digital switching has helped eavesdroppers immensely in automating their activities and made it possible for them to do their listening a long way from the target with negligible chance of detection.

Police work was not born with the invention of wiretapping and at present the significance of wiretaps as an investigative tool is quite limited. Even if their phone calls were perfectly secure, criminals would still be vulnerable to bugs in their offices, body wires on agents, betrayal by co-conspirators who saw a brighter future in cooperating with the police, and ordinary forensic inquiry.

Moreover, cryptography, even without intentional back doors, will no more guarantee that a criminal's communications are secure than the Enigma guaranteed that German communications were secure in World War II. Traditionally, the richest source of success in communications intelligence is the ubiquity of busts -- failures to use the equipment correctly

Even if the best cryptographic equipment we know how to build is available to them, criminal communications will only be secure to the degree that the criminals energetically pursue that goal. The question thus becomes, "If criminals energetically pursue secure communications, will a government standard with a built in inspection port, stop them."

It goes without saying that unless unapproved cryptography is outlawed, and probably even if it is, users bent on not having their communications read by the state will implement their own encryption. If this requires them to forgo a broad variety of approved products, it will be an expensive route taken only by the dedicated, but this sacrifice does not appear to be necessary.

The law enforcement function of the Clipper system, as it has been described, is not difficult to bypass. Users who have faith in the secret Skipjack algorithm and merely want to protect themselves from compromise via the Law Enforcement Exploitation Field, need only encrypt that one item at the start of transmission. In many systems, this would require very small changes to supporting programs already present. This makes it likely that if Clipper chips become as freely available as has been suggested, many products will employ them in ways that defeat a major objective of the plan.

What then is the alternative? In order to guarantee that the government can always read Clipper traffic when it feels the need, the construction of equipment will have to be carefully controlled to prevent non-conforming implementations. A major incentive that has been cited for industry to implement products using the new standard is that these will be required for communication with the government. If this strategy is successful, it is a club that few manufacturers will be able to resist. The program therefore threatens to bring communications manufacturers under an all encompassing regulatory regime.

It is noteworthy that such a regime already exists to govern the manufacture of equipment designed to protect 'unclassified but sensitive' government information, the application for which Clipper is to be mandated. The program, called the Type II Commercial COMSEC Endorsement Program, requires facility clearances, memoranda of agreement with NSA, and access to secret 'Functional Security Requirements Specifications.' Under this program member companies submit designs to NSA and refine them in an iterative process before they are approved for manufacture.

The rationale for this onerous procedure has always been, and with much justification, that even though these manufacturers build equipment around approved tamper resistant modules analogous to the Clipper chip, the equipment must be carefully vetted to assure that it provides adequate security. One requirement that would likely be imposed on conforming Clipper applications is that they offer no alternative or additional encryption mechanisms.

Beyond the damaging effects that such regulation would have on innovation in the communications and computer industries, we must also consider the fact that the public cryptographic community has been the principal source of innovation in cryptography. Despite NSA's undocumented claim to have discovered public key cryptography, evidence suggests that, although they may have been aware of the mathematics, they entirely failed to understand the significance. The fact that public key is now widely used in government as well as commercial cryptographic equipment is a consequence of the public community being there to show the way.

Farsightedness continues to characterize public research in cryptography, with steady progress toward acceptable schemes for digital money, electronic voting, distributed contract negotiation, and other elements of the computer mediated infrastructure of the future.

Even in the absence of a draconian regulatory framework, the effect of a secret standard, available only in a tamper resistant chip, will be a profound increase in the prices of many computing devices. Cryptography is often embodied in microcode, mingled on chips with other functions, or implemented in dedicated, but standard, microprocessors at a tiny fraction of the tens of dollars per chip that Clipper is predicted to cost.

What will be the effect of giving one or a small number of companies a monopoly on tamper resistant parts? Will there come a time, as occurred with DES, when NSA wants the standard changed even though industry still finds it adequate for many applications? If that occurs will industry have any recourse but to do what it is told? And who will pay for the conversion?

One of the little noticed aspects of this proposal is the arrival of tamper resistant chips in the commercial arena. Is this tamper resistant part merely the precursor to many? Will the open competition to improve semiconductor computing that has characterized the past twenty-years give way to an era of trade secrecy? Is it perhaps tamper resistance technology rather than cryptography that should be regulated?

Recent years have seen a succession of technological developments that diminish the privacy available to the individual. Cameras watch us in the stores, x-ray machines search us at the airport, magnetometers look to see that we are not stealing from the merchants, and databases record our actions and transactions. Among the gems of this invasion is the British Rafter technology that enables observers to determine what station a radio or TV is receiving. Except for the continuing but ineffectual controversy surrounding databases, these technologies flourish without so much as talk of regulation.

Cryptography is perhaps alone in its promise to give us more privacy rather than less, but here we are told that we should forgo this technical benefit and accept a solution in which the government will retain the power to intercept our ever more valuable and intimate communications and will allow that power to be limited only by policy.

In discussion of the FBI's Digital Telephony Proposal --- which would have required communication providers, at great expense to themselves, to build eavesdropping into their switches --- it was continually emphasized that wiretaps were an exceptional investigative measure only authorized when other measures had failed. Absent was any sense that were the country to make the proposed quarter billion dollar investment in intercept equipment, courts could hardly fail to accept the police argument that a wiretap would save the people thousands of dollars over other options. As Don Cotter, at one time director of Sandia National Laboratories, said in respect to military strategy: ''Hardware makes policy.''

Law, technology, and economics are three central elements of society that must all be kept in harmony if freedom is to be secure. An essential element of that freedom is the right to privacy, a right that cannot be expected to stand against unremitting technological attack. Where technology has the capacity to support individual rights, we must enlist that support rather than rejecting it on the grounds that rights can be abused by criminals. If we put the desires of the police ahead of the rights of the citizens often enough, we will shortly find that we are living in police state. We must instead assure that the rights recognized by law are supported rather than undermined by technology.

At NSA they believe in something they call 'security in depth.' Their most valuable secret may lie encrypted on a tamper resistant chip, inside a safe, within a locked office, in a guarded building, surrounded by barbed wire, on a military base. I submit to you that the most valuable secret in the world is the secret of democracy; that technology and policy should go hand in hand in guarding that secret; that it must be protected by security in depth.

Recommendations:

There is a crying need for improved security in American communication and computing equipment and the Administration is largely correct when it blames the problem on a lack of standards. One essential standard that is missing is a more secure conventional algorithm to replace DES, an area of cryptography in which NSA's expertise is probably second to none.

I urge the committee to take what is good in the Administration's proposal and reject what is bad.

- The Skipjack algorithm and every other aspect of this proposal should be made public, not only to expose them to public scrutiny but to guarantee that once made available as standards they will not be prematurely withdrawn. Configuration control techniques pioneered by the public community can be used to verify that some pieces of equipment conform to government standards stricter than the commercial where that is appropriate.

- I likewise urge the committee to recognize that the right to private conversation must not be sacrificed as we move into a telecommunicated world and reject the Law Enforcement Exploitation Function and the draconian regulation that would necessarily come with it.

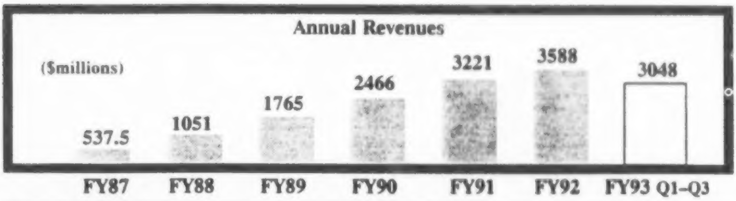
- I further urge the committee to press the Administration to accept the need for a sound international security technology appropriate to the increasingly international character of the world's economy.

Sun Microsystems, Inc.
Facts At A Glance
April 1993

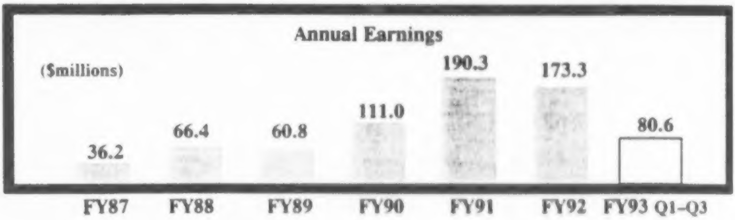
Public Relations: (415) 336-7700
Investor Relations: (415) 336-0699

BASIC INFORMATION

Products	Sun Microsystems, through its subsidiaries, is a leading manufacturer of systems for client-server computing: workstations, servers, system software, printers, networking products and related products that use the UNIX operating system.
Founded	February 1982
Employees	13,381 as of March 1993
Market Share	In 1992, Sun remained the workstation market leader (IDC). Unit shipments: Sun: 38.3% HP: 17.1% DEC: 12.1% IBM: 7.3%
Financials	Q3 FY93 revenues (ended March, 1993): $1.14 B Q3 FY93 earnings: $51.7 M #139 on Fortune 500 (up from 181 last year) Revenues per employee: $300,500 R&D Investment: 9.5% of revenues in Q3 FY93 Sun's common stock is traded on the National Market System under the symbol SUNW.



Annual Revenues



Annual Earnings

The Companies in Sun Microsystems:
- Sun Microsystems Computer Corp. (workstations and servers)
- SunSoft (system software)
- Sun Technology Enterprises
  - SunConnect (networking products)
  - SunPics (printing and imaging products)
  - SunPro (software development tools)
  - SunSelect (PC emulation products)
  - SunSolutions (collaborative software products)
- SunExpress (telemarketing and fast order fulfillment)
- Sun Microsystems Laboratories (R&D work-for-hire for Sun companies)

Manufacturing/Engineering

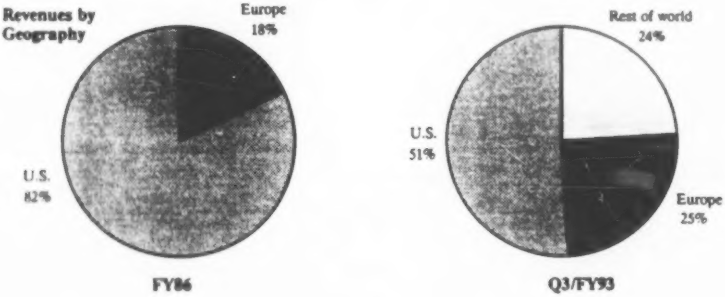
Sun products are built in Milpitas, California
Chelmsford, Massachusetts
(180,000 square feet), and in Linlithgow, Scotland
(210,000 square feet).

- European engineering center (Grenoble)
- Canadian development center (Montreal)
- European logistics center (Frankfurt)
- Japan Engineering Center (Tokyo)

International

By the end of the third quarter FY93, 49 percent of Sun's total revenues came from non-U.S. sales. Sun has 26 offices around the world providing full sales, service and technical support. Within Europe, Sun has operations in the United Kingdom, France, Italy, the Netherlands, Spain, Sweden, Switzerland, Finland, Belgium, Germany, Poland, Hungary and Greece and has distributors in eight more countries. Sun also has sales and marketing operations in: Japan, Australia, Mexico, Brazil, Central and South America, Canada and the Asia Group, which handles Hong Kong, Singapore, People's Republic of China, Taiwan, Korea, India and all of Southeast Asia.

Revenues by Geography



FY86

Q3/FY93

Distribution

Sun sells its products through its direct sales force, through distributors and through resellers such as VARs and its National Value-Added Dealers (NVAD) channel, which services the commercial market.

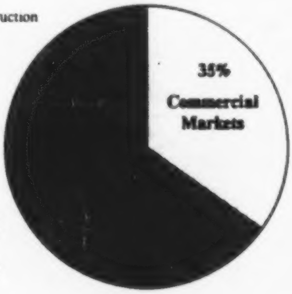
Sun System Revenues by Application

Technical Markets

- Architecture/Engineering/Construction
- Aerospace
- Automotive
- Education/Research
- Electronics
- Government/Military
- Healthcare
- Oil/Gas
- Pharmaceutical/Chemical

Applications

- Computer-Aided Manufacturing
- Electronic Design Automation
- Earth Resources
- Geographic Information Systems
- Mechanical CAD
- Scientific
- Software Development



FY92

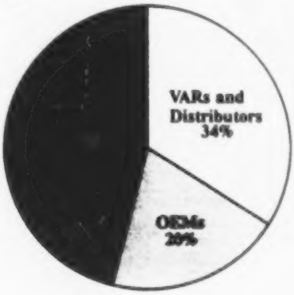
Commercial Markets

- Banking
- Insurance
- Publishing
- Retail
- Securities
- Telecommunications
- Transportation

Applications

- Commercial CASE
- Connectivity
- Document Imaging
- Personal Productivity
- RDBMS
- Software Development
- Structured Documentation

Sun's Worldwide Channel Mix FY92



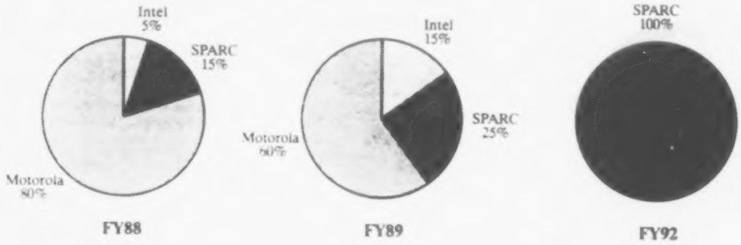
FY92

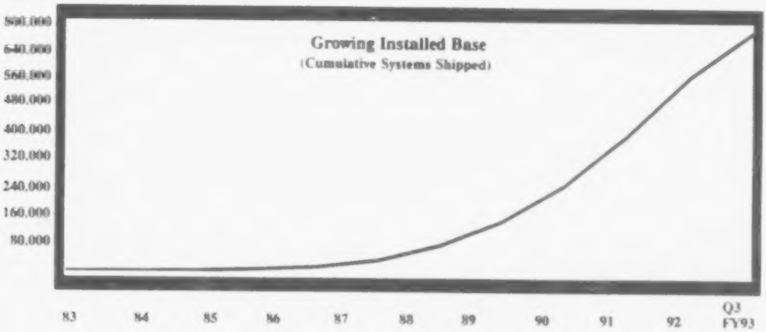
PRODUCTS

Sun Microsystems was a pioneer in the general-purpose workstation market, having launched the now-popular concept of open systems. Sun's networked UNIX products improve workgroup productivity, utilizing the client-server computing model, in which "client" workstations are connected to "servers" that store and manipulate information. Sun systems and software give computing power and ease of use to groups in both business and technical environments.

Installed Base As of March 1993, more than 800,000 systems had been shipped worldwide. The Sun computing platform features SPARC/Solaris technologies, which offer high performance, openness, ease of use and superior networking. While Sun continues to support its Motorola and Intel-based lines, SPARC comprises 100% of shipments.

Hardware Revenues by Microprocessor Type





History

Sun Microsystems:

The 10-Year Success Story

Sun's early history,
major milestones,
and its growing impact
on the computer industry.

Public Relations Dept.
Sun Microsystems, Inc.
February 1992

Upstarts Launch Startup

Trying to convince Bechtolsheim to start Sun, Khosla said: "I want the goose that laid the golden egg; not the golden egg."

Stanford graduate student Andreas Bechtolsheim thought he had a good thing going. The tall, blond Bavarian spent 1981 licensing rights at $10,000 a pop to a new computer he had designed. Called the Sun (for Stanford University Network), this early workstation was powerful and cheap because it was made of off-the-shelf parts. Working on his thesis at Stanford, Bechtolsheim realized there were few affordable systems for engineers and scientists, hence his Sun project. Fired up by time he had spent at Xerox's fabled Palo Alto Research Center (PARC) -- where the concept of easy-to-use, networked desktop computers was invented -- Bechtolsheim also had a vision of an "open" system that would run UNIX.

Reportedly, Stanford decided, after calling DEC and Prime, that the project had no value. In those days, it was believed computers should be proprietary, as were the industry's first workstations, introduced by Apollo in 1981. Thus Bechtolsheim used his own money -- about $25,000 -- to build prototypes. And demand for his system was strong.

Word-of-mouth about Bechtolsheim's Sun project traveled to Stanford MBA graduate Vinod Khosla, a native of India. Khosla had always had strong entrepreneurial instincts; he attempted to start a company in New Delhi right after getting an engineering degree. His dream for years had been to found a company in Silicon Valley -- and to retire before age 30.

Early in 1982, he tracked down Bechtolsheim. Khosla had just left Daisy, a CAE pioneer he had helped found in 1980, because he had concluded what the industry needed was a general-purpose workstation rather than Daisy's concept of specialized hardware. From Khosla's first meeting with Bechtolsheim, it was clear that this reserved yet intense European was mainly driven not by money but by a vision of a different computing world that did not yet exist. After he offered Khosla the usual $10,000 license, Khosla made a suggestion that would eventually change both of their lives. Recalled Khosla, "I said to him, I want the goose that laid the golden egg; I don't want the golden egg. I told him we could build a big company, that we could raise a few million dollars. He would be a founder of the company." At first, Bechtolsheim said he wanted to finish his Ph.D., but he was finally convinced to join forces with Khosla.

Khosla's golden goose -- Bechtolsheim -- was a loner during his boyhood in Germany who tinkered with radios at home while other boys played soccer. Although he has always been most fascinated by architecture, this lifelong perfectionist has had to be content with becoming one of the world's premier computer designers. Highly intelligent and driven, yet soft-spoken, Bechtolsheim always felt a little "different" until he arrived in the U.S. to pursue his technical education. "All of a sudden, there were all these people who shared similar interests," he remembered.

After agreeing to start Sun, Bechtolsheim and Khosla put a business plan together in Bechtolsheim's office at Stanford. Khosla was to be president and Bechtolsheim vice president of technology of the new company. Negotiating over a hamburger in a local McDonald's, Khosla next hired Scott McNealy, a fellow Stanford MBA, who left his job as director of operations at a small high-tech firm

According to Bechtolsheim, "When Bill (Joy) and I met, it was like a mind merger." The two both had a dream of open systems.

to join the fledgling company as co-founder. He would run Sun's manufacturing.

The son of an American Motors executive, McNealy admits he didn't study as hard as he could have while earning an economics degree from Harvard, even though he had received a perfect score on the math portion of the SATs. While waiting to get into Stanford's MBA program, he left academia for his preferred environment -- the business world -- for four months, as a manufacturing foreman at Rockwell. In fact, he labored there with such intensity, opting to put in seven-day weeks of 15-hour days, that he temporarily landed in the hospital.

There were many early signs that McNealy had a knack for leadership: in 1972, he captained his suburban Detroit high school tennis team to a state championship and narrowly missed doing the same for the hockey team. His golf game was ranked twelfth in the state. Later, as a young director at the company he joined before Sun, McNealy had serious quality problems to address. He turned things around in just two months by helping employees to see the best solution rather than just barking orders at them. And he immediately saw the promise in Sun.

Within a few weeks, the group had initial venture capital funding, thus Sun Microsystems, Inc., was incorporated in February, 1982. The next order of business was adding to the staff. Unfortunately, Khosla had less success trying to lure top executives from major computer companies to Sun than he had recruiting Scott McNealy. "When you're 26 years old, look like a little kid, talk with a funny accent and have just three people in your company, you don't get very far," he said.

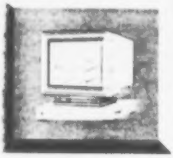
• • •

Khosla got a better response when approaching Bill Joy, who later joined as head of R&D. A tall Berkeley graduate student from Michigan, Joy, too, demonstrated early evidence of high intelligence: he was named a National Merit Scholar in high school and won a statewide math competition. At Berkeley, he became widely known as a UNIX guru, having designed a popular version of the operating system. Explained Khosla: "If Bill called DEC and said, 'I need a VAX,' they used to say they'd deliver a whole six-pack of VAXes, free. They really wanted his work at Berkeley to continue, so I think he had 10 or 12 VAXes in that one room all to himself."

"(Sun) thought I had offers from lots of other companies," remembered Joy. "The truth was, no one had ever asked me before." The addition was brilliant; Joy's software expertise perfectly complemented Bechtolsheim's creativity in hardware. In fact, Joy was also a believer in low-cost open systems and had been handing out UNIX tapes based on the operating system he had designed for a $100 copy fee "because he realized that was a way to create something important," explained Bechtolsheim. "When Bill and I met, it was like a mind merger."

However, to some in the industry, the future of Sun might have seemed less promising: its 26- and 27-year-old founders had little or no "meaningful" (as Khosla defined it) work experience. In those early days, the East Coast computing establishment didn't understand Sun. "They thought we were quirky," Khosla recalled. One reason was because Khosla hated smokers, thus wouldn't hire a smoker or a coffee drinker -- at least, for the first 20 employees.

Meanwhile, chief rival Apollo was led by



Apollo's leaders dismissed Sun with comments like, "Everything that's loose rolls to the West Coast."

industry veterans who were old enough to be the fathers of Sun's youthful crew. Apollo was everything Sun wasn't: a conservative East Coast company committed to its own proprietary technologies. In fact, Apollo's leaders dismissed Sun with public comments like, "In this country, everything loose rolls to the West Coast," according to then-chairman Thomas Vanderslice. But a portent of things to come was the fact that Sun had a prototype and a customer -- another start-up named Solo -- just three months after being founded. And Sun was aiming high. "We said, 'We want to take on IBM and DEC,'" remembered Khosla. "And we wanted to take them on in the mainstream businesses, not in the little niches that most other companies were aiming at."

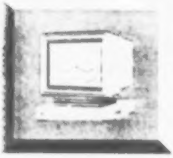
The First Big Arrow Hits Apollo

Sun moved quickly from the very beginning. Manufacturing commenced -- in what local press dubbed "an oversized garage" in Santa Clara, Calif. -- in the spring of 1982. The co-founders and a handful of employees assembled the first few hundred units mostly by hand. "I'd never done anything like it before," remembered McNealy. "Here I was, my hands getting blistered by a screwdriver." But soon, Sun settled into a product philosophy it follows to this day: off-the-shelf components, streamlined designs and extensive outside assembly, which results in quick time-to-market and low prices. Within six months of incorporation, the company became profitable.

The Sun-1 and subsequent Sun-2 were instant successes, with 80 percent of the first year's $8 million in sales coming from the university market. The wildfire response to Sun's products soon helped the company recruit experienced employees. Joining Sun in 1983 were many able young professionals who had been stars at big companies. Among them were Carol Bartz, who came from DEC and soon headed up marketing, and Larry Hambly, a highly skilled sales and marketing manager with experience at Symbolics, Data General and other firms. Another newcomer that year was Eric Schmidt, a multiple-degree technical expert who had done stints at Xerox's PARC and Bell Labs.

While many new companies would have been content with such an overwhelming response from the university market alone, Sun's founders were eyeing bigger prey. They felt they needed major wins in other areas if they were to achieve their ambitious objectives. Just 17 months after Sun's incorporation, the company was aggressively pursuing a large contract to sell workstations to major CAD supplier ComputerVision. This big company had decided to abandon its proprietary hardware and choose a new platform for its products. The winning company would make millions of dollars supplying ComputerVision with systems for resale.

What happened next has become part of Sun folklore. Despite spirited arguments and an enticing deal from Sun, ComputerVision picked Apollo. Nevertheless, Sun personnel hurriedly drafted a new proposal and overnighted it to top CV executives. In addition, a Sun hit team took the redeye East in order to be in the CV lobby the next morning. During hours spent in the lobby making phone calls to CV executives, the Sun team was told that the deal was closed and that Apollo was still the winner. But the Sun group only agreed to leave after the CV sales chief said he would call later to explain the choice. During this call and a subsequent clandestine meeting, the Sun team made another offer, which was accepted. This put Sun on the map in the mainstream technical market.



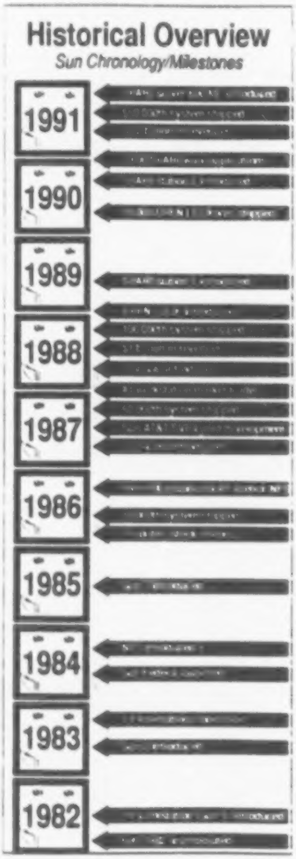
"It was a real eye opener for me when McNealy came in in a polo shirt and high-fived me in the hallway," said a new executive at Sun.

The ComputerVision episode cemented the rivalry between Sun and Apollo, with Sun winning other important business away from the larger firm. Growing so rapidly, Sun had already moved out of its first site and into a larger building in Mountain View next to San Francisco Bay. Before long, adjacent buildings were inhabited. In those days, McNealy's office resembled, according to the *Wall Street Journal*, a "'60s dorm room," including pins on a wall map locating the top U.S. golf courses. Said one newly-hired vice president: "It was a real eye opener for me when McNealy came in in a polo shirt and high-fived me in the hallway." Yet McNealy's casual, humorous style was matched by one of the quickest minds in the industry; he was able to uncannily foresee the future and plan accordingly years before anyone else. In 1984, he was named president; Khosla had realized his goal of becoming a millionaire several times over and retired from daily management of Sun.

The seemingly casual environment belied the fact that Sun was moving rapidly on all fronts to become a major player. International sales were sought early -- the first European office opened in January of '84 -- and new products were rushed out every few months. In that same year, Sun launched a subsidiary, Sun Federal, to serve the government market. And Sun continued to champion (almost singularly in those days among computer companies) open systems, designing and licensing to all comers NFS, file sharing software that soon became the industry standard.

Fun, Profits and Envy

Sun's laid-back California location and youthful attitude forged a high-energy, yet playful corporate culture that appealed strongly to the bright engineers and marketers coming out of the top universities or working in older, slower-moving companies. Coming to Sun in



Historical Overview

Sun Chronology/Milestones

Getting to work ith Bechtolsheim and Joy was like "winning a Fulbright scholarship" to the engineers joining Sun, one reporter noted.

1984 as manufacturing director was Curt Wozniak, a graduate school chum of McNealy's -- and still a fellow hockey player -- whose resume included stints at HP and General Motors. The following year, Wayne Rosing, who had led a key development team at Apple, joined Sun. And industry heavyweights were also coming to Sun, as well. It was considered a coup when Sun snared Harvard economist and Xerox executive Bill Raduchel, who became Sun's CFO. His years as a high-level strategist would prove invaluable. Another prestigious hire was former 17-year DEC veteran and DEC executive officer Kevin Melia, who took over operations at Sun.

Skilled technical professionals were flocking to Sun in large numbers by the mid-80s. According to many observers, they were attracted by the presence of technical experts like Bechtolsheim and Joy. Even though neither man maintained the usual vice president's trappings -- staffs, budgets and related paperwork -- both were highly respected in their roles as "visionaries without portfolio." In fact, after interviewing Sun engineers, one reporter said the attitude of the technical community was that getting to work with these two was like "winning a Fulbright scholarship."

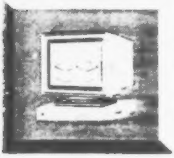
But people were coming to Sun not just for the professional challenge but also for the fun. Friday beer busts became a fixture, with everyone from top management to entry-level workers attending. Another tradition established early was an annual April Fool's prank, with such stunts as placing Bill Joy's Ferrari on a platform in the middle of a decorative pond within Sun's growing "campus" one year and disassembling and reassembling an entire Volkswagen inside an executive's office the next. But work was also getting done. Every year, it seemed Sun was doubling, tripling or quadrupling its financial successes from the year before.

Competitor Apollo was particularly angry about Sun's ability to offer systems priced significantly below Apollo's proprietary computers. The party line at Apollo in those days was that "standards are a stupid idea." But the marketplace was beginning to disagree. In 1984, to combat Sun, Apollo was forced to abandon its exclusive design and produce a system that operated on standard software. Commenting to journalists about Sun's incessant price cutting, Apollo's chairman Vanderslice offered a sad shake of the head and the advice, "I wouldn't have done that." Yet soon after -- to head off Sun's relentless drive into Apollo's customer base -- the company was forced to drop prices itself.

Meanwhile, Sun continued making rapid gains in important technical market segments and winning converts to its philosophy of open systems. The gap -- both cultural and strategic -- between Sun and Apollo, DEC, IBM and other large East Coast computer companies remained huge. The year after Sun's wildly successful initial public offering in 1986, McNealy told reporters about the ongoing zeal of Sun employees: "We're a Fortune 500-size company but I have trouble finding a parking space at 5:30 p.m.," he said. In contrast, parking lots at Apollo's Massachusetts headquarters were almost empty in the evening and on weekends. Said Ed Zander, then Apollo's vice president of marketing, "We're pushing to get people to work the 41st hour of every week."

In 1987, Sun streaked past Apollo in sales, with revenues increasing 146 percent from the previous year. Not too long afterward, Zander left Apollo to head up marketing at Sun. A year later, six-year-old Sun hit one billion dollars in annual sales.

Birkenstocks and RISC



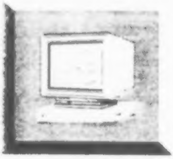
The SPARCstation 1 launch wasn't like "a product rollout from a vacuum cleaner company," McNealy joked.

While Sun's success brought with it considerable financial rewards. Sun's top executives actually appeared little changed from their college days. Bechtolsheim. the reserved German hardware guru. still loped around the Sun campus in his Birkenstocks and pursued his longtime mission of designing ever-more-powerful computers. "You have to obsolete your own product," he said. "Anytime you try to protect your past. you're in trouble because the future is cheaper." Meanwhile. Joy -- who still wore the bulky sweaters and "determinedly unkempt hair," according to the *Wall Street Journal*, of his Berkeley days -- was helping Sun continually refine its UNIX, designing other important software like NFS. and taking a lead role in plotting new directions for the company. One important element in Sun's success was kernel designers like Joy. According to a Sun executive, there are "very few UNIX hackers in the universe," and Sun had a disproportionate share. Meanwhile, McNealy -- who was quickly earning notice and respect in the computer industry for his innovative strategies and keen leadership -- drove the same old compact car for several years after Sun became a household name among engineers and the press. His penchant for casual clothes and acerbic. funny quips still separated him from the buttoned-down CEOs in the industry. Perhaps McNealy's only bow to his demanding position was the fact that he now had an email terminal and fax machine installed in his home.

This individualistic attitude extended to Sun's many able engineers, as well. According to a product manager at another company, "Apollo has young people, but they're always in the back. You can walk right into Sun and start talking to their Twinkie eaters anytime." Thus it was no surprise that Bechtolsheim found many Sun engineers who were eager to help him design a new computer in 1987. At that time, most Sun systems were based on the widely available Motorola 68000 microprocessor. However. Sun had designed its own powerful RISC processor -- after many leading firms refused to develop CPU chips for Sun -- that was called SPARC. Sun had turned the design over to a few silicon vendors for implementation and had new systems to be introduced later that year. But Bechtolsheim envisioned an entirely different sort of SPARC system. This was to be a small, high-performance, low-cost desktop system with a completely new appearance. In addition, it would utilize several breakthrough designs aimed at giving the system expanded -- yet inexpensive -- capabilities. According to one Sun executive, "Andy was way ahead of everybody in seeing the potential of desktop machines."

Bechtolsheim was so convinced of the rightness of his new idea that he continued working on it, even though Sun was focused on larger systems in those days. But given Bechtolsheim's incredible track record as a system designer, Sun's leaders soon decided to take a chance on this never-been-done-before computer. The system was dubbed the SPARCstation 1. It would eventually employ new levels of integration, miniaturizing the essential electronic components into a CPU package called "the pizza box" for its small size. Just like they had with many Sun innovations, other companies later borrowed the concept and the term for their own products.

The SPARCstation 1 was introduced with great fanfare on April 12, 1989, at a gala event in San Francisco. McNealy joked that he hoped this product launch would dispel comments from the press that events put on by cost-conscious.



By the late '80s, the biggest players in the computer industry were no longer viewing Sun as a harmless little West Coast company with non-traditional strategies.

techie Sun were like rollouts by a vacuum cleaner company. And it was no accident that competitor Hewlett-Packard -- a distant number four in the workstation market in 1988 -- chose the same day to make a major announcement. In a costly bid to heave itself into the leader's position, it had bought Apollo.

Within a short time, the SPARCstation line became the most popular RISC workstation on the market. And evidently, HP's attempt to buy market share via the Apollo purchase wasn't successful in giving HP the lead. By the end of 1989, according to International Data Corp., HP had only moved up to third place in terms of total shipments.

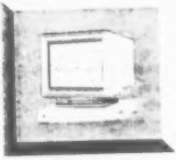
Standards and Anti-Standards

Some time before the SPARCstation was launched, the biggest players in the computer industry were no longer viewing Sun as a harmless little West Coast company with non-traditional strategies. Sun was dominating what had become the computer industry's major growth segment: workstations. And everyone wanted to rule this important market. But worse yet, Sun was moving beyond its technical stronghold into the enormous commercial markets that many large vendors considered to be their exclusive turf.

Although IBM's first product offering in the workstation space, the RT, was one of its few blunders, Big Blue got serious with its next machine. Clearly, HP meant business, too, as evidenced by its acquisition of Apollo. And DEC was fighting hard, using methods like an unprecedented trade-in deal on Sun systems for those purchasing DEC computers (this ploy ultimately didn't result in very many trade-ins, analysts reported). McNealy knew that Sun would have to watch its back. But that didn't stop the company's long-time evangelism of open systems, or the creation of ever-new strategies (such as focusing on a single computing platform, as Sun soon did with SPARC), or Sun's increasing sales.

Licensing technology for little or no cost was part of Sun's commitment to open systems. The Bill Joy-designed NFS, released in 1984, was the first Sun product broadly licensed; it became the industry standard for file sharing. Two years later, Sun hoped to overcome the diversity of incompatible window systems then on the market by inexpensively licensing its advanced new window technology, NeWS (Network-extensible Window System). Repeatedly given the highest possible praise from software types (it was called "elegant"), NeWS was more sophisticated and a better product than anything else then available. But even as trade magazines were writing eagerly about what a great solution NeWS could be, large computer vendors were vowing not to let Sun claim another technical victory by establishing a second major industry standard. The big firms threw their support behind MIT's X Window System as the standard. Although not as "elegant" as NeWS, it had the big advantage of not coming from a vendor, particularly too-successful Sun.

Despite the rebuff to NeWS, Sun did not stop championing open technologies. Later, Sun and original UNIX creator AT&T (at its famous Bell Labs facility) forged a partnership under which the two would design a new version of UNIX that would unite many of the existing flavors of the operating system -- and become the industry standard that software developers and users needed. But that was too much for the world's largest computer vendors. In 1988 -- in response to the Sun/AT&T alliance, virtually every neutral observer said -- IBM, HP, DEC and a roster of other vendors formed the Open Software Foundation



"The real problem is that IBM, DEC and Unisys have a bunch of products no one wants to buy," an analyst said.

(OSF). There was much irony in the formation of OSF. Many of the industry giants in this consortium had pooh-poohed UNIX in the past; a widely quoted statement from DEC president Ken Olsen was that those promoting UNIX were offering "snake oil." Nevertheless, OSF announced plans to develop a new "standard" UNIX of its own.

Despite this powerful gang's objective, the AT&T/Sun operating system, System V Release 4, is widely viewed today as the leading UNIX.

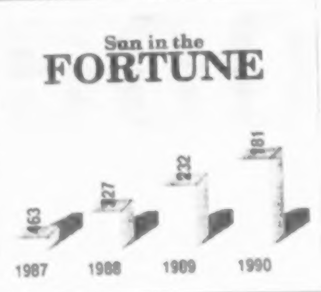
The Open Systems Revolution

While some people were surprised over the sudden interest in UNIX -- and the unprecedented alliance of former competitors -- demonstrated by OSF, Sun wasn't. For years, McNealy, Bechtolsheim and Joy had been predicting industry consolidation and a user revolt away from closed architectures and toward open systems. What was surprising, however, was the degree of turmoil in the industry as a result of this new computing religion, since it wasn't just the recession that was beginning to hurt computer firms. In fact, one well-known analyst told the press that, "I caution against believing any company that blames the economy for its problems. Technology products, not economics, dictate buying patterns. The real problem is that IBM, DEC and Unisys have a bunch of products that no one wants to buy." And while these companies slashed their workforces and watched their profits plunge, Sun was riding the open systems wave. *Fortune* magazine named Sun the fastest-growing U.S. company between 1985 and 1989, with a compound annual growth rate of 114 percent.

Said McNealy at the end of the '80s: "DEC or IBM would love to see (open systems) go away, but it is absolutely unstoppable. It's the irresistible force in the world today. Companies cannot sell proprietary, single-vendor solutions to the computer marketplace. Just like Ford cannot introduce an automobile that is 50 feet wide or that has the brake pedal to the right of the accelerator."

Car analogies are as much a part of McNealy as clever quips. No wonder. He spent his childhood listening to his father chat about business with family friend Lee Iacocca on the golf course. In fact, during many evenings at the McNealy home, young Scott plotted strategies with his dad -- vice chairman of American Motors Corp. -- to save the troubled firm. One lesson he learned was the importance of having market share, since a company without it -- like AMC had been -- was condemned to skate "on the hairy edge of not quite having critical mass," said McNealy. He also knew the wisdom in always keeping the competition off balance.

The SPARC licensing strategy -- one of Bill Joy's many far-thinking ideas -- did just that. In order to rapidly build this critical mass for SPARC systems, Sun



"We're not going through a phase," noted Apple's John Sculley. "We're going through a fundamental change." And evidence of this was strange new alliances.

encouraged the creation of a whole SPARC market by licensing its technology. While some skeptics argued that SPARC clones could hurt Sun, just as PC clones cost IBM market share, Sun's leaders disagreed. They knew there was a world of difference between *planning* a cloning strategy versus dealing with their unwanted existence after they appear. "IBM grew a $7 billion PC business in spite of the clones," McNealy argued in 1989. "Hurt me with that problem."

Hurting Sun was what just about every major company in the computer industry had in mind. As the open systems revolt picked up further steam in the '90s, virtually every company was rewriting its product strategies. Open systems was the new buzzword -- with the meaning stretched and pulled so that it would apply to just about anything.

Old Enemies Become New Friends

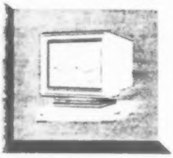
As the new decade began, Sun had, indeed, fulfilled its founders' ambitions to take on the big boys. But the company still had its youthful irreverence. An amusing promotional video was titled "Never Grow Up," even as McNealy, Joy and other Sun leaders were cutting sophisticated deals with major companies worldwide. Joy -- gliding around Sun in his battered Reeboks and passing out wisdom on topics from primitive art to history -- and McNealy -- a self-proclaimed "wise guy" whose outrageous quips perked up any story -- were still more likely to wear jeans to the office than suits. "The tie is one of the most dysfunctional articles of clothing ever invented," McNealy told one reporter. "The only dress code we have is that you must."

Coupled with its success, Sun's uninhibited culture made for lively copy among members of the press. Speaking for all those who followed Sun, one analyst summed up the common view: "Sun is so much fun to watch."

And, in fact, the entire computer industry was making headlines as never before. It seemed as if the unprecedented level of competition created by the open systems revolution was inspiring new behaviors from the giant vendors, all of whom wanted to replace Sun in the top spot and were willing to do just about anything to make it happen. Staid Hewlett-Packard launched the most aggressive ad campaign in its history, directly attacking Sun and even using false information. Typical of the new fervor was an HP pep rally at which a sales team ceremoniously ripped up a photo of Scott McNealy.

Yet despite such zeal, Sun still managed to firmly lock up the leader's position. IDC named Sun a strong number one at the end of 1990, with 39 percent of worldwide workstation and server shipments. HP followed distantly with 20 percent, then DEC at 17 percent and IBM trailing with 4 percent. That meant that Sun's share was more than HP's and DEC's combined. According to a former Apollo vice president, Sun's leaders were successful "because they don't have preconceived notions about what can't be done." And Sun's SPARC strategy was also succeeding. According to IDC, 65 percent of 1990 RISC shipments were based on SPARC. The next largest processor had a mere 18.5 percent share.

The top computer companies weren't just battling against Sun. They were grappling with an industry in which the old rules no longer applied. Explained Apple chairman John Sculley to *USA Today*: "We're not going through a phase. We're going through a fundamental change." And in dealing with this change, many companies were forging odd new alliances. One headline-grabbing example was the Advanced Computing Environ-



Said one frustrated ACE planner: "Every time we appear to have Sun cornered. Scott McNealy comes along and pops his head up again."

ment (ACE), composed of strange bedfellows Microsoft, DEC, Compaq, chips producer MIPS and other firms. Many analysts noted that ACE seemed to be Microsoft's attempt to extend the hegemony it enjoyed with the aging PC into the more-powerful computing environment being chosen in the '90s. Initially saying it would support two new operating systems and two processors, ACE's list of supported operating software has grown since then. "Programmers won't be holding their breath," wrote one reporter.

The industry soon saw another mind-boggling alliance, this time between arch-enemies IBM and Apple. Not surprisingly, the goal of this team was to develop yet another next-generation computing platform to breathe new life into the PC and grab the market away from Sun. Reporters noted that both ACE and the new Apple/IBM duo seemed plagued by a need to hold onto existing products while also touting something new. The result was a mishmash of different products -- current and promised -- that left users wondering about just what the future would really bring.

Among the confused were software developers. The president of one leading company told the *Los Angeles Times* that "There's never been a technology product fostered by a coalition that has been successful." Sun's Ed Zander had a similar view: "You have to be willing to bet your company on a strategy. Then it can work." The president of Forrester Research thought he understood the real agendas inherent in the confusing new plans of the consortia. "I don't see any unifying themes, except perhaps a desire to wound Sun," he told the press. In fact, sometimes the frustration of Sun's competitors even bubbled over into later-regretted statements in the newspaper. One member of the ACE consortium told the *New York Times* that "Every time we appear to have Sun cornered, Scott McNealy comes along and pops his head up again." And again. And again.

Statistics
(1991)

FY revenues: $3.2 billion Earnings: $190 million
Fortune 500 ranking (1990): #181
Employees: 12,500 worldwide
Employee statistics:
- **Average age is 36**
- **35% are female, 65% are male**
- **61% are married, 39% single**

FY91 Regional sales:
U.S. - 49%; Europe - 30%, rest of world - 21%
Installed base: 550,000+ systems

Dealing With New Business Realities

The computer buyers of 1991 never had it so good. Cost-cutting was rampant and it seemed like the high profit margins that had propped up companies like Apple and Compaq in the old days were gone for good. One high-tech executive called these price reductions "a rape and pillage strategy." To counter the fierce competition and falling prices, companies needed both tight management and laser-like prescience about what buyers wanted on a scale that the industry had never seen before.

Following the bizarre new consortiums, more incredible events were taking place. Compaq suffered a large loss -- its first ever -- and quickly fired its president/co-founder; mergers were rampant, such as AT&T's acquisition of NCR and the new entities of Borland/Ashton Tate and Novell/Digital Research. And virtually every big company was laying off large numbers of unlucky employees.

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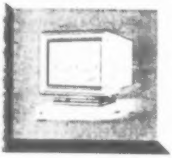

The computer industry was going through a profound change that would require new attitudes and strategies. The president of one small software company told the *Wall Street Journal* that the industry "has reached a glass ceiling. Ganging up against one another isn't going to be the answer. The solution is a new approach."

Sun executives had begun planning *their* new approach the previous year. While Sun seemed to ride above the turmoil in the industry -- the company's fiscal 1991 financial performance was the best of any computer vendor -- McNealy knew that streamlining was in order. Product and distribution trends were changing so quickly -- and would change even more in the future -- that Sun needed to change as well to keep itself far ahead of the competition. One Sun executive had explained the company's situation well to *Business Week*: "As a big company, everything we do now is like flying a supersonic jet at treetop height. You can't afford to make mistakes."

Although Sun's piloting had been remarkably precise, McNealy didn't want to take chances. As they grow, companies often slow down; decision-making becomes a consensus issue while taking risks is often viewed as a politically unwise move. That had never been Sun's philosophy and was, many said, part of the company's success formula. Thus, in the summer of 1991, McNealy organized Sun Microsystems into subsidiaries. In effect, this created several smaller, fiercely competitive companies with nimble decision-making and focus -- like several younger Suns.

The subsidiaries still aim to offer the innovative, competitively priced products based on open technologies that Sun has been known for. However, each of the seven companies addresses a core business or function, with most operating as a separate profit and loss center. And each subsidiary has its own management, which oversees things like product development, manufacturing, marketing and sales. According to McNealy -- who remains as chairman and CEO of Sun but also now heads up the largest subsidiary, Sun Microsystems Computer Corp. -- this structure enables management to put

THE COMPANIES WITHIN SUN

Sun Microsystems Computer Corp. -- The largest business unit, SMCC develops, manufactures and markets workstations and servers. It also integrates and sells products from other Sun business units (such as system software from SunSoft). A subsidiary within SMCC is Sun Microsystems Federal, which does hundreds of millions of dollars in business among federal, state and local governments. Scott McNealy is president of SMCC and also chairman and CEO of Sun Microsystems, Inc.

SunSoft Inc. -- This company develops and sells system software (specifically, the Solaris distributed computing environment) to other firms, including SMCC. SunSoft's goal is to proliferate Solaris, thus it offers Solaris on SPARC as well as Solaris on the Intel x86 to a variety of hardware vendors. Recently, SunSoft acquired the operating systems business of Interactive Systems, formerly part of Eastman Kodak. Since this operation was a leader in UNIX on Intel, SunSoft's move into this market will be significantly enhanced. Ed Zander is president of SunSoft.

Sun Technology Enterprises, Inc. -- This organization functions as a portfolio manager, handling three independent business units (SunConnect, SunPics and SunPro). Eric Schmidt is president.

SunConnect, Inc. -- A member of the Sun Technology Enterprises family, this business offers network management and interoperability products. The focus is on products that link UNIX systems with other environments (such as DEC and IBM systems and PCs). Dena Yaro is acting general manager.

SunPics, Inc. -- Another Sun Technology Enterprises company, it makes printing and imaging hardware and software products for UNIX networks that enhance flexibility. Bill Marr is vice president and general manager.

SunPro, Inc. -- The third Sun Technology Enterprises company, it is the leading supplier of SPARC/UNIX programmer productivity products, such as programming environments and compilers. Jon Kannegaard is vice president and general manager.

SunExpress -- The focus of this company is to offer end users and resellers quick, easy ordering and delivery of non-system Sun products, such as software, add-on products and peripherals. SunExpress is based in Boston and will have an international operation established in 1992. Dorothy Terrell is president.

Sun Microsystems Laboratories, Inc. - The R&D organization is not an actual business unit but rather an advanced development arm utilized by the operating companies in Sun Microsystems. Wayne Rosing is vice president.

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Joy's latest blue sky idea is a computer that will disappear right into the desk, with a screen as its surface.

resources where they'll do the most good. Never a profligate company, spending-wise, Sun long ago learned how to run lean in order to offer the outstanding product price/performance that helped it outrace its rivals. The aggressive companies that now make up Sun are all committed to the bottom line. These days, visitors to McNealy's office see a new addition to his desk: a sign that says "President and Cheap Executive."

And once again, this industry visionary seems to have started something. While Sun's new organization was aimed at increasing its already-significant success, other companies are emulating McNealy's new structure for less positive reasons. Throttled by an overgrown bureaucracy and experiencing perhaps the biggest crisis of its many decades in business, IBM announced it would decentralize into more independent entities. Many expect some other large companies to make similar moves. As of early 1992, companies like DEC and IBM were reporting large losses, signalling further drastic changes ahead for the industry.

Orbits of Sun's New Planets

Sun's new structure hasn't significantly altered the basic company — personnel and facilities remain the same. Sun management knew that the energy, ideas and unconventional attitudes that had become so much a part of Sun culture must be left intact. People like Andy Bechtolsheim, Bill Joy, and many other technical innovators at Sun still do what they always did. In fact Joy's latest blue sky idea is a computer that will disappear right into the desk, which will have a screen as its surface. Meanwhile, Bechtolsheim is defining the next generation of desktop computers and talks of a day when computers will be the size of credit cards and simply plugged into a keyboard.

Running the new subsidiaries are many familiar faces at Sun. Curt Wozniak heads up engineering while Larry Hambly runs marketing in Sun Microsystems Computer Corp., the workstation and server manufacturer. Ed Zander is the chief of SunSoft, the system software subsidiary. Overseeing several independent businesses that focus on areas like development tools, connectivity products and printing and imaging products is Eric Schmidt, president of Sun Technology Enterprises. And Wayne Rosing is now in charge of Sun's long-range research and development as head of Sun Microsystems Laboratories.

Much on the minds of all Sun executives was evolving an effective sales structure that would reflect the rapid changes in the industry. Carol Bartz leads Sun's 6,500-strong direct sales force, which has always given the company a competitive edge. In addition, Sun still uses a variety of reseller partners and has launched a new channel: SunExpress, which is committed to fast order fulfillment of non-system products. This company is headed by DEC veteran Dorothy Terrell.

Sun's new planets have every intention of utilizing the aggressive, innovative business model that has made Sun Microsystems the scorn, then the envy and the bane of the computer industry. "Could any (other company) do the same?" speculated analyst Mark Stahlman recently.

"Sure they could. If they really wanted to and had the years to spend. But then where would they be? If they moved as fast as Sun has, they would still be behind, simply because Sun has no plans to stop racing ahead on its own."

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Mr. BOUCHER. Thank you very much, Mr. Gage.

Dr. Herron, we will be pleased to hear from you.

Dr. HERRON. Mr. Chairman, subcommittee members: I'm a research chemist working on the discovery of new treatments for diseases, and increasingly over the last 5 to 10 years high performance computing and networking have become a central feature of that type of discovery research.

We've been also involved in planning for the development of our use of high performance computing and networking in medical projects that would allow us to share medical and scientific information more effectively and to do a better job of carrying out our clinical trials on new agents.

We've been very fortunate in trying to carry out these programs to be involved in a partnership with the National Center for Supercomputing Applications at the University of Illinois. We joined a partnership with them in 1988 and they helped us enormously with our initial supercomputer applications and visualizations and network applications, and gave us the background information that we needed to establish our own supercomputer center at Lilly in 1990. But even having our own facility, we find it enormously beneficial to work, continue to work with the NCSA because they are able to keep us in touch with the most current advances in hardware and software, and in ideas for new applications, much, much more so than we could possibly do within our own relatively small and circumscribed company.

The kinds of work that I do frequently involve the simulation of the behavior of relatively complicated molecules. The estimation of how well one molecule will interact with some target even before that putative drug has ever been made, this is potentially a very powerful way to get at new agents faster and with less error.

We can't really do this as well as we would like to, though, even as fast as our current hardware and software is, the calculations that we can do on molecules now are quite limited in how realistic they can be. We really need to be able to look at large numbers of molecules together, interacting, and we need to be able to do a better job of estimating the structures of large molecules, and we need probably a thousand to ten thousandfold faster computers to be able to do that than we have now.

In addition to that, the networks have to develop because we need to be able to share this enormous amount of computational information that is generated all over the country at very large cost so that people don't constantly duplicate these calculations and pay for them over and over again.

And also the amounts of information about science and medicine and clinical trials that need to be shared to do these things the way we would like to really involves handling unprecedentedly large amounts of data in realtime.

So, to summarize the main points that I made, we believe that high performance computing and high speed networking is important to the effectiveness and competitiveness of drug discovery, and we feel that it is important that agencies like the NSF that provides support to the National Supercomputer Centers that have been so useful to us be carried on.

And we also hope, being in industry as I am, that you will try to allow industry to be—my industry, in particular, to be an active partner in the development of these very powerful new technologies.

[The prepared statement of Dr. Herron follows:]

HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS IN THE DISCOVERY OF NEW DISEASE THERAPIES

Testimony Before the
Subcommittee on Science
Committee on Science, Space and Technology
United States House of Representatives

by

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May 11, 1993

INTRODUCTION

Mr. Chairman and members of the Subcommittee, my goal as a research scientist is to discover molecules that have the potential to be new and superior treatments for serious diseases. My own laboratory, and the other laboratories in my research group, are devoted to discovering new treatments for asthma, and other serious inflammatory diseases of the lung. Other similar research groups at Lilly are devoted to searching for new treatments for AIDS, Alzheimer's Disease, Cancer, and other diseases that cause death or debilitation and for which adequate treatments do not yet exist. Even when the molecules that we discover cannot be developed into new drugs, they sometimes serve as tools that expand our understanding of the disease targets. It is exciting and gratifying to be able to understand molecules in all of their complexity and beauty, to work in the laboratory to construct them, to discover how a totally new kind of molecule behaves with a biological target molecule such as an enzyme or a receptor, and at last to see if the molecule truly treats the disease that you have hypothesized that it would treat.

This process used to be carried out without very much knowledge of the three-dimensional (3-D) structures of the drug candidates. Many molecules from a variety of sources were simply tried in a test, and if some activity was detected, many analogs of the active molecule were synthesized and tested until the most potent member of the chemical family was found. Now we usually have a much better mechanistic idea of what we want a molecule to do to treat a disease. Increasingly we work from a 3-D structure of a molecule--either a molecule whose 3-D structure we want to mimic, or a target molecule such as an enzyme or a receptor, that has an opening that we want to fill with our putative new medicine. Sometimes a 3-D structure is available from x-ray crystallographic studies, or from nuclear magnetic resonance (NMR) studies, but sometimes a target of great interest will not crystallize or will not yield helpful NMR data, and so a 3-D structure has to be estimated using demanding computational methods.

THE ROLE OF HIGH PERFORMANCE COMPUTING

The computers available to us at Lilly in 1988 were not capable of dealing with such demanding computational tasks. Many of the calculations that were essential to our drug design work would have taken months or years to complete on the conventional machines available to us then. A breakthrough for us came in January, 1988 when we joined the Industrial Partners Program at the National Center for Supercomputing Applications (NCSA) at the University of Illinois at Urbana-Champaign.

I and other Lilly Scientists were able to learn from the superb people at the NCSA how to carry out supercomputer calculations, how to visualize the massive amounts of numerical data that resulted, and how to write programs for supercomputers. In addition we were able to gain a better grasp of what possible applications supercomputing might have within our company and what costs and management issues are involved in operating a supercomputer system.

One of my coworkers, Dr. Robert B. Hermann, was able to estimate the 3-D structure of an enzyme, human synovial phospholipase A_2 (sPLA_2), which is thought to be involved in inflammatory diseases such as rheumatoid arthritis and septic shock, using molecular dynamics calculations carried out on Cray supercomputers at NCSA. This structure was used by Lilly scientists to begin to design small molecules that could fit into the sPLA_2 active site and stop the enzyme from acting in inflammatory diseases. Later, when members of our x-ray crystallography group were able to crystallize sPLA_2, Bob's calculated structure was used to aid in solving the x-ray crystallographic structure, which was published in Nature on July 4, 1991. We now use x-ray crystallographic and computed structures in our structure-based design of sPLA_2 inhibitors. The approach has been fruitful in helping us to understand how the enzyme works and to discover the kinds of inhibitors that we have sought. Lilly hopes to be first in the world to discover if a human sPLA_2 inhibitor can be a superior new therapy for serious inflammatory disease.

Bob and I were also able to create an innovative computer program, called SUPER, that can compare 3-D structures of molecules in ways that are useful in drug design. SUPER is only practical on a very fast computer like a Cray. Runs that take days or weeks on a conventional machine are finished in a few hours on a Cray 2 supercomputer. Our work on SUPER was published in the Journal of Computer-Aided Molecular Design in 1991, and I use it routinely in my own research.

Leukotrienes are molecules that are produced in the lungs during asthma attacks, and exacerbate the asthma attacks. We wanted to discover new molecules that would block the actions of leukotrienes in the lungs, much as an antihistamine blocks actions of histamine produced during allergic reactions. As part of this effort, I carried out long molecular dynamics simulations of the 3-D structures of the leukotrienes, and worked out revealing methods for visualizing the results. These experiments suggested a characteristic T-shape of the leukotriene D_4 molecule, which was used by Lilly scientists in the design of new leukotriene D_4 receptor antagonists which we hope will be effective new drugs for the treatment of asthma.

The speed of the supercomputers is important for this kind of work, but the networking is also important, because we did not have to travel to Champaign-Urbana to carry out these calculations, but carried them out remotely from Indianapolis, and then transferred the massive output files to Indianapolis electronically over a network connection. The network connection was also valuable to us for sharing software created by NCSA workers and made available to everyone on the Internet. Internet communication is invaluable to me in collaborating and sharing data with scientists at universities and biotechnology companies that are essential ingredients in our competitiveness.

While current supercomputers are fast, they are not fast enough for the kind of work that is involved in drug design. Simulating the behavior of large molecules like proteins, RNA, or DNA, for instance; or carrying out simulations on two or more molecules interacting, are already essential to our work, but current supercomputers cannot carry out these massive calculations in any useful time frame, and so less effective approximate methods currently have to be used. When 10,000 times faster molecular dynamics calculations can be carried out on our molecules, we will be able to design new drugs more quickly and more unerringly. We would like to be able to put a putative enzyme inhibitor in an enzyme active site and carry out a long enough simulation to explore all of the possible ways that the inhibitor can fit into the active site, and find out which of those ways is the most preferred by the enzyme-inhibitor complex. We can't do that now. Instead we put the inhibitor in the active site several different ways (perhaps not including the right one) and simulate around each of those. We would also like to be able to simulate an inhibitor moving from the space near an enzyme into the active site to see how the structure of a molecule affects its ability to get into the enzyme, but again to do this well will require the next generations of supercomputers.

Empowered by the knowledge gained from our interaction with NCSA, Lilly established its own supercomputer center in Indianapolis in 1990. Lilly computational facilities have continued to blossom since then. In spite of our internal capabilities now, we still interact with the NCSA to be aware of and have access to the state of the art in hardware, software, and thought. I can't overemphasize how exciting, stimulating, and mind-expanding it is to interact with such outstanding people, representing a much broader cross-section of the state of the art in computer applications than we can possibly have at Lilly. I have found that unexpected interactions with people from many disciplines at NCSA have exposed me to new ideas and information that are proving invaluable to me in my drug discovery work. Our current interaction with NCSA provides us opportunities to explore possible applications of such tools as massively parallel computing, virtual reality, human interface design, high speed networking, intelligent agents and other massive data sharing approaches. This kind of interaction is incredibly important for keeping us at the leading edge in our field. It would be good if the barriers to such interactions were lower, for instance, if there were more support available for specific joint industry-supercomputer center projects.

In addition to my involvement with molecular design, I have also been part of Lilly's exploration of ways to apply modern computing and communication technologies to the medical side of drug discovery. We have been exploring better ways to provide information to scientists, physicians, patients, hospitals, and government agencies that we work with world-wide, and also better ways of collecting and sharing information from patients and physicians about the patients' health and the effectiveness of any drug treatments that they may be receiving. Eventually we envision a world wide information superhighway that will improve our definition of diseases, will improve our ability to detect new diseases quickly, will empower us to carry out better and safer clinical trials of new therapies and communicate the results more quickly and understandably to appropriate government agencies. These approaches have enormous potential for improving the practice of medicine and the development of new disease therapies. These improvements have potential for reducing the cost of health care by detecting disease early, by promoting self care, and by facilitating the discovery of new treatments that are more economical than surgery or hospitalization.

CONCLUSIONS

The availability of high speed computers, new computer architectures, new software, innovative human interfaces, fast information sharing networks, and stimulating environments for the creative applications of these tools are important if the U.S. pharmaceutical industry and its newer biotechnology counterparts, are to make as quickly as possible the improvements that are needed for the health of our people and if we are to remain the world leaders that we are today in these areas. Agencies such as the National Science Foundation which has provided so much of the support for the NCSA's programs should have funds available to facilitate the continued maintenance and development of high performance computing and high speed networking applications. The NCSA and the other centers are invaluable resources, and should be fully supported. As a member of industry, I hope that industry as well as the government and the universities will be made a partner in the new age of high performance computing and high speed networking in the United States . As I mentioned earlier, direct support for specific collaborative industry-government center projects would be very beneficial. I think that it is vital for our competitiveness that we work together. It would be good if funds for implementing the high performance computing and high speed networking program could be obtained by the appropriate centers without their having to use so much of their manpower scrambling from agency to agency seeking funding to do their work. It would be good to let as much of their manpower and mental energy as possible focus on actually doing the work itself. I am excited by the potential of these programs to benefit our health, productivity, and competitiveness.

Mr. BOUCHER. Thank you very much, Dr. Herron.

Dr. Weingarten?

Dr. WEINGARTEN. Thank you, Mr. Chairman.

First, I would like to extend apologies from Ed Lazowska. What we had thought was simply a sore throat over the weekend that was making it difficult to speak turned into a fairly serious medical problem that required some minor surgical care but kept him in Washington.

On the other hand, it's certainly a pleasure for me to return to this Committee. I have not testified here since I was at OTA some years ago, so it's a pleasure to be back.

The basic message of our testimony is that we think H.R. 1757 is exactly on track and ought to be passed as soon as possible. The bill recognizes the need to move beyond the focus of the High Performance Computing and Communications Act on developing basic computing and telecommunications technologies and experimenting with grand challenges and move them into application areas, particularly applications that focus on public needs: education, libraries, public health, government services of all kinds.

We also applaud the bill because it recognizes that the technology base for all these applications doesn't yet exist and will require developing the research, an applied research base in order to achieve some of these visions we have.

The points in the testimony as Ed had written them are really five. One is that advances in computing have already been phenomenal, and I think some people following me will elaborate on that point. A more important point I think is number two, and that's that these advances have been the result of a very highly effective partnership between government, academia and industry, and I'd like to return to that point a little later on when I try to address some of the questions that Mr. Johnson raised.

A third point is that history is prologue. As far as we've come now, we have a lot farther to go, and the opportunities are just beginning to show themselves—increases in power, the interconnection of computers with communications systems to form entirely new kinds of information environments, the portability of computing, the vast increase in storage and decrease in the cost of electronic storage—all of these coupled together mean that we have an enormous new range of opportunities, particularly to serve the public sector.

And finally, this won't just happen. It does require strong government investment in research and human resources, like the High Performance Computing and Communications Act, 1757, and other types of government programs, and especially a focus with respect to making the basic technology usable, and usable throughout our society.

Now, one of the cautions that we wanted to make on the bill is that we need a financial commitment as well as authorization. In other words, these bills don't really help with NSF's research budget being cut or held flat. They are more good intentions rather than the reality of programs if we can't follow up authorization with appropriations. So we would just caution the Congress or ask the Congress to consider this, the importance of following up these kinds of commitments with real dollars.

And with that in mind I would like to at least rise to the challenge presented by Congressman Johnson, because I think the point he raises is in fact a deeply held concern in the Congress and is reflected by many Members of the Congress, and they are reflecting, in fact, the feelings of the public.

A couple of points. First, the government has been involved in computing and developing the computer industry in a partnership between academia and industry dating back to the late 1940s. In fact, computing to me is one of the great success stories of a well-managed government/industry/academic partnership dating back to the 1940s when a group of scientists broke off from the Defense Department and formed something called Engineering Research Associates from which flowed virtually the U.S. computer industry.

In the 1960s the Atomic Energy Commission and the Defense Department jointly funded the development of a few supercomputers, experimental supercomputers. Much of the technology that flowed out of that development was in turn used by IBM and other computer manufacturers in their commercial lines.

The field of computer science, which I represent here, was really created by investments by ARPA and the National Science Foundation throughout the last 2 or 3 decades. So the question is not really whether the government should intrude in this very successful activity. The question is whether we should now back out of that or whether we should move it forward.

The government has acted, I think, in a very successful partnership with the private sector so far, and judging from the success of the computer industry, economic and social success, I think we should question very carefully before we move out of that, and I would certainly suggest that we need to move forward and adapt that relationship to modern needs.

We cannot stop investing for the future. We in the scientific community, I think, are coming to understand very well the need to set priorities and the realities of scientific research funding, and are certainly willing to work with the government in trying to establish those kinds of priorities. But at the same time we cannot stop investing in the future of our economy, and the future of our technological development by any measure that I see of the nature of our economy in the next century is going to be high tech. It is going to be dependent on innovation.

We also cannot switch these on and off depending on the day-to-day exigencies of the budget. We can't establish facilities and not staff them. We can't establish research groups and not provide them with the materials from year to year that they need to do their work.

Finally, this bill focuses on public sector, and therefore reflects a concern with specific government responsibilities. Education, libraries, public health—these are all activities that are really government activities that we are trying to build the infrastructure to serve, and therefore it seems to me a particularly clear responsibility of the government to push the technology forward in this direction.

We have a couple of other comments in our testimony and suggestions, and I'd be willing to, of course, answer any questions you might have later. Thank you.

[The prepared statement of Dr. Lazowska follows:]

Statement of

Edward D. Lazowska

Professor of Computer Science & Engineering
University of Washington
and
Member of the Board of Directors
Computing Research Association

U.S. House of Representatives Subcommittee on Science
Hearing on the High Performance Computing and
High Speed Networking Act of 1993, H.R. 1757

May 11, 1993

Mr. Chairman and Members of the Subcommittee, my name is Ed Lazowska. I am a Professor of Computer Science & Engineering at the University of Washington and a member of the Board of Directors of the Computing Research Association, on whose behalf I am pleased to testify today.

The Computing Research Association represents organizations that conduct research in computer science and computer engineering in North America. The members of the Association are nearly 150 academic departments and industrial laboratories. Your Subcommittee's outstanding work, both on H.R. 1757 this year and on H.R. 656 two years ago, is of keen interest to us, and of critical importance to America's future.

In my testimony today, there are five points that I would like to emphasize:

1. Advances in high performance computing and communications have been phenomenal.
2. These advances have been the result of a highly effective partnership between government, industry, and academia.
3. As phenomenal as these advances have been, "you ain't seen nothin' yet" -- the next decade or two is the period in which digital technology can truly transform America.
4. This transformation won't just happen, though. It will be possible only with stronger investment in basic research and human resources in computer science and computer engineering -- something that received short shrift in the implementation of the High Performance Computing Act of 1991.
5. The High Performance Computing and High Speed Networking Applications Act of 1993 seems precisely on target to us, although we do have several suggestions concerning implementation.

1. The Advances Have Been Phenomenal

Astounding advances in computing have become so routine that I sometimes worry we are in danger of taking this progress for granted.

I entered college at about the same time as your Chairman -- 25 years ago, in the late 1960s. Our computing equipment was the latest and greatest: Thomas J. Watson, Jr., was an alumnus of my undergraduate institution, and its ties to him and to IBM were strong. But the Macintosh that I have in my briefcase -- 8-1/2 x 11 inches and four pounds -- has about 25 times the memory and 10 times the processing speed as the building-sized mainframe that served the entire academic and administrative needs of Brown University just two decades ago!

Here is a frequently-used analogy: If, over the past 30 years, transportation technology had made the same progress as computing technology in size, cost, speed, and energy consumption, then an automobile would be the size of an attaché case, cost $200, travel 100,000 miles per hour, and go 150,000 miles on a gallon of fuel.[1] Changes of this magnitude are revolutionary, not evolutionary.

It's incredibly difficult to accurately predict this kind of progress. I recently ran across a chart from 1972 that synthesized a number of "expert predictions" concerning progress in "large scale" computing.[2] The experts' predictions for 1990 -- which undoubtedly seemed wild back in 1972 -- turned out to be low by a factor of about 25 both for memory capacity and for processing speed! And the experts' predictions for the year 2000 are a factor of 1000 below current estimates for where we will be by then.

But as difficult as it is to predict this kind of progress, it's even more difficult to forecast *the changes that will be brought about by such progress*. Electronic data processing, yes -- but who would have guessed compact disc players, cellular phones, CAT scanners, FAX, or electronic prototyping environments? Who would have predicted that computation would join physical experimentation and mathematical analysis as a third basic paradigm for how to do science and engineering? Who could have known that major areas of biology and computer science would converge with one another due to the digital nature of the human genome?

Were it not for the contributions of computer science and computer engineering research, we would not even be *dreaming* of attacking the "Grand Challenge" problems of science and engineering, or of creating a National Information Infrastructure to unite America.

2. A Highly Effective Government/Industry/Academia Partnership Has Brought This About

Although I consider this point to be absolutely essential, I shall not belabor it here. My industrial colleagues on this panel can bear witness to the importance of this partnership. Intel has, of course, done enormous amounts to advance the state of the art in scalable multicomputers, and to make these systems practical -- but the cube architecture itself, the message-passing programming paradigm, the operating system software, and many key high-performance algorithms all are recent products of Federally-funded university computer science and computer engineering research, and much of the early use of Intel's systems took place in Government laboratories. Similarly in the case of MasPar: single-instruction multiple-data architectures and the data-parallel programming model are fresh from university laboratories.

The record of technology development and transfer -- of exchange in all directions along all three edges of the government/industry/academia partnership triangle -- is unprecedented; I cannot think of another field that enjoys comparable relationships. We must not lose this momentum.

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[1] As my baseline I have used the Digital Equipment Corporation PDP-1, a semiconductor machine that represented an enormous cost/performance improvement when it was introduced in 1963.

[2] R.E. Lynch and John R. Rice. *Computers: Their Impact and Use*. Holt, Rinehart and Winston, 1975.

3. "You Ain't Seen Nothin' Yet"

Here, I would like to draw upon the testimony before this Subcommittee two weeks ago of my friend Richard Rashid, Director of Research for Microsoft.

Advances in computing are indeed making it possible to attack the "Grand Challenge" problems of science and engineering -- problems of enormous importance.

With even greater pervasiveness, though, advances in computing are enabling what Dr. Rashid referred to as the "digital information revolution ... New technologies make it easier to transform analog messages, including the spoken word, text or pictures, into the digital language of computers which then can be transmitted, processed and stored electronically. In digital electronic form, textual, audio and video information can be combined, [and] used by a variety of different machines in new and exciting applications. ... In 25 years we will look back and ask how we ever got along when information was in analog form."

Innovative applications of digital information will "create markets for a wide variety of new products and services", and will "offer American businesses and consumers -- wherever located -- benefits in such areas as education and health care, and improved access to government information and libraries". Applications of high performance computing and communications -- of digital technology and digital information -- will transform America, strengthening its economy and uniting its people.

4. Stronger Investment in Basic Research and Human Resources in Computer Science and Computer Engineering is Essential

Today's amazing digital technology is the direct result of yesterday's investments in basic research and human resources in computer science and computer engineering.

Tomorrow's even greater advances, and the changes that they will bring about in American life, will be possible only if we invest today.

Digital technology has progressed so far, the speed of computing devices is so great, the things we can do are so remarkable, that many people are tempted to believe that the technology to achieve a vision such as that embodied in H.R. 1757 is on the shelf and ready to be deployed. I commend the Subcommittee for recognizing that this is not the case -- for making it explicit in H.R. 1757 that further investments are essential in basic research and human resources in computer science and computer engineering, both in general (Sec. 307, "Research in Support of Applications", Para. a, b, and c) and in the specific application areas covered by the Act (all sections, but as an example, Sec. 309, "Applications for Health Care" -- the topics enumerated in this section are *core research issues in computer science and computer engineering).*

I would like to provide just a few specific examples of the role of computing research in areas related to the High Performance Computing Act of 1991 and the High Performance Computing and High Speed Networking Applications Act of 1993. I will steer clear of the obvious, such as designing and prototyping computer architectures and network architectures offering ever higher performance -- but one should not lose sight of the fact that the high performance computing and networking technologies upon which these Acts are based are largely the products of *Federally-*

funded university computer science and computer engineering research:

Digital Libraries

On April 23, David Patterson, Chairman of the Computer Science Division at U.C. Berkeley and a fellow member of the Board of Directors of the Computing Research Association, along with Edward Ayers, an historian from the University of Virginia, gave a seminar here on digital libraries which Jim Wilson helped organize and which some of your staff members attended.

Twenty years from now, with sufficient attention paid to the issue, people will roll their eyes in amazement at the way in which we use libraries today. ("You mean you physically took the only copy back to your office?!?!") And as the Subcommittee knows, a key benefit of digital information in general and digital libraries in particular is that they benefit all of America -- and have the potential to benefit remote areas even more than major metropolitan areas.

Because of the last generation of advances in computing, much of the basic hardware to support digital libraries exists today: Berkeley's current $47M library construction project will house 2 million books, which could be stored on $500,000 worth of electronic media. And in certain restrictive application domains, digital libraries are a reality today. A friend of mine works for a San Francisco law firm which undertook two major infrastructure projects five years ago: to build, at great cost, what is considered to be one of the finest private law libraries in the nation, and to place a personal computer on every attorney's desk. I'm told that because of the access to online legal information that the personal computers afford, the spectacular new law library is used now mostly for photo ops and social gatherings.

But don't be misled! We are a long way from being able to build a digital library of the scale and sophistication envisioned by H.R. 1757. The computer science and computer engineering research issues that need to be addressed, many of which are identified in the Act, include storing the incredible volume of information; managing the memory hierarchy to achieve reasonable access times; locating information; dealing with the demands of multimedia documents (text, images, music, voice, video, etc.); accommodating variations in communication and display capabilities; achieving reliability; designing compression algorithms to improve cost/performance; designing advanced user interfaces; devising new cryptographic protocols to help in dealing with copyright/use issues; the list could go on and on. And there are, of course, myriad policy issues, as well.

"SILK" Interfaces

Advanced user interfaces are just one aspect of digital libraries -- and of government information systems, and of health care systems, and of many education applications. I must observe that this commonality emphasizes the importance of supporting core research in computer science and computer engineering, so that these common problems get solved once, solved generally, and solved right.

In the past several years, advances in hardware technology and in algorithms have placed nearly within reach interfaces that employ speech, images, language, and knowledge -- so-called "SILK" interfaces.

Interfaces that understand speech in a limited domain of discourse are already in commercial use. (Try dialing an AT&T long distance credit card call and failing to enter your credit card number at the chime.) Systems that work usably well in a general setting have been demonstrated in the laboratory. Storage technology has advanced remarkably -- it would be possible to preserve every sound you utter in your lifetime in a shoebox full of compact discs. (But we lack the indexing technology to make use of this information.)

High-resolution color images require a significant amount of storage, and color video requires significant network bandwidth, but these are now within reach. The day of digital movies sent to the home via a fiber optic network is not far off, and aggressive use of images and video in user interfaces is becoming common.

Technology to understand language also is making rapid advances through progress in the hardware and software domains. Uses of this technology include a wide range of reading and writing aids: tools for highlighting and summarizing articles; greatly improved spelling, grammar, and style checkers; "filing assistants"; etc. Technology to generate language, coupled with speech synthesis hardware, is already common: programs that read stored text aloud are a boon to the sightless; programs that read columns of numbers in a spreadsheet facilitate verification.

Interfaces that incorporate knowledge can be made "forgiving" (tolerant of errors and ambiguities) or helpful (able to suggest alternatives, through "self awareness" and awareness of user patterns).

Over the coming years, progressively more sophisticated "SILK" interfaces have the potential to revolutionize the ease of use of digital systems. Computer science and computer engineering research such as this is essential to the success of the National Information Infrastructure, making its services accessible and useable by the broadest possible constituency.

Mapping the Human Genome

Leroy Hood moved his National Science Foundation Science and Technology Center in Molecular Biotechnology from Caltech to the University of Washington this year. The establishment of a new program in Seattle was made possible by a $12M endowment from Bill Gates, Chairman and CEO of Microsoft Corporation.

Genetics and computer science are arguably the two most rapidly changing areas of human knowledge, and their potential for synergy is one of the great challenges to the human imagination. Perhaps the most important discovery in 20th century biology was not the discovery of the DNA double helix, but rather the realization that the double helix provides a common *digital* fabric on which all life is built. Recent analytical advances are making this digital information directly accessible to biologists. The results are revolutionizing the discipline. Biology has long been an information-rich field; the newly acquired digital information has the extreme virtue of being in a common language across all living systems. Biological research is becoming strongly driven by this growing digital data base. Among other things, it often allows rapid identification of common functional components of widely divergent organisms -- from yeast to worms to humans. A gene involved in sexual reproduction in yeast, and one involved in multiple-drug resistance in human cancer cells, have been discovered to be nearly identical. The defective gene responsible for cystic fibrosis was identified and sequenced a few years ago, revealing that the underlying mechanism of the disease is a defect in a protein involved in ion transport across cell membranes; in an instant, decades of work on cystic fibrosis was inextricably linked to decades of work on cell membranes.

There are two keys to the state of the art in this research. First, obviously, are the elegant advances in laboratory techniques that allow extraction of such detailed genetic information. Equally essential have been computational advances: increasingly sophisticated algorithms allowing construction of genetic maps and sequence data from a variety of experimental sources, inference of evolutionary trees, sequence similarity comparison and data base search, etc. Further advances in the art will require progress on both key areas -- in biology and in computer science and computer engineering. As one example, the defective gene responsible for Huntington's disease was identified and sequenced earlier this year. Unlike the case with cystic fibrosis, computer search discovered no known similar genes, so no clues were gained to the structure or function of the associated protein. This is the case with two-thirds of newly-sequenced genes, and there is strong evidence that this is intrinsic to the current algorithms. More complete genetic data will only increase the success rate marginally; what is needed are substantially more powerful algorithms for similarity comparison between DNA sequences. Achieving this goal will require the collaboration of computer scientists and molecular biologists -- it is most assuredly not the sort of problem that will be solved by hiring more programmers and giving them faster computers.

These few examples can barely begin to illustrate the fundamental role that computing research must play in achieving the goals of the Acts. The human resource requirements are equally significant. At all degree levels, the demand for computer scientists and computer engineers remains strong. The enormous new business opportunities that will be created by the digital information revolution are but one factor working to ensure that this will continue to be the case.

A key concern of the Computing Research Association is that the implementation of the High Performance Computing Act of 1991 *fell far short* of placing sufficient resources into basic research and human resources in computer science and computer engineering, particularly within the National Science Foundation. The Computing Research Association would emphasize:

- Basic research and human resources in computer science and computer engineering are essential to achieving the goals of the Acts -- both short-term goals and long-term goals. *Advances in computer science and computer engineering fuel these initiatives.*

- To ensure a well-balanced program, a significant amount of this support must be provided through non-mission-oriented agencies -- most particularly the National Science Foundation, which sustains the broad fundamental technology base.

- *By any measure*, existing support for computing research is low. Consider:

    - Computing is a foundation technology -- advances in computing have a pervasive effect.

    - It is estimated that the computing industry accounts for 10%-20% of the gross domestic product. The software industry *alone* contributed $37 billion of value added to the U.S. economy in 1992.[3]

    - It is estimated that the Federal government spends $150 billion per year on computing.

  Yet the support for computer science and computer engineering research in the National Science Foundation is only about $110 million per year.[4]

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[3] *The U.S. Software Industry: Economic Contribution in the U.S. and World Markets.* Economists Incorporated, March 1993.

[4] An additional $96 million per year is spent on the Supercomputer Centers and on NSFNet. It is important to note that while the Supercomputer Centers are a valuable national resource and have been instrumental in effecting a paradigm shift in many areas of science and engineering, they have *not*, for the most part, been relevant to the advancement of the computer science and computer engineering research that supports high performance computing. The Centers have deployed current generation HPCC technology, not developed the next generation of this technology.

- Because the basic level of support for computing research is so low, particularly within the National Science Foundation, it is critical that new initiatives be supported with new money, rather than "repainting" existing projects or diverting funds from those projects. *Authorization without appropriation may actually have a negative effect.*

5. H.R. 1757 Is Right On Target

The Computing Research Association strongly supports H.R. 1757. This is the right time for an Applications Act, and this is the right Act. The application areas are well-selected: they are of great importance and of broad societal impact, and they are natural extensions of the advances in high performance computing and communications that have been achieved.

Throughout the Act, there is a clear commitment to basic research in support of these advanced applications -- a recognition that the ambitious goals of the Act require further advances in core computer science and computer engineering research areas such as high-speed network protocols, high-speed network management, network security and privacy, advanced user interfaces, new approaches to visualization and to computer-mediated collaboration, improved means to organize and search enormous distributed databases, and so forth. Advances in computing technology are so great that it is necessary to continually re-think basic approaches. A rule of thumb is that performance doubles every 18 months. Imagine the upheaval in the telephone system if the volume of calls went up by a factor of 10, or in the air traffic control system if the speed of aircraft went up by a factor of 10, or in the nation's highway system if the speed of automobiles went up by a factor of 10. This is what happens to computing technology every five years!

The demonstration projects are essential, not just because they will allow the technology to be developed and prototyped, but because they will provide a forum for the government and the private sector to consider critical regulatory issues based upon experience rather than speculation.

We think it important that Sec. 5 clearly authorize the National Science Foundation to continue to support the development and use of networking services by the research and education community.

More broadly, while we appreciate the concerns of the telecommunications industry as expressed in their policy statement[5] and in testimony before this Subcommittee, we would point out that Federally-funded research and education networking is a *customer* for private sector services, not a competitor, and that this "Internet community" has been responsible for *creating* both the technology and the applications of high performance communication! The Computing Research Association feels that attempts to legislate a strict separation between "production networks" and "experimental networks", and to place detailed restrictions on the use of the latter, are incompatible with the nature of the Internet and would paralyze future advances. As noted recently by Douglas Van Houweling, Vice Provost for Information Technology at the University of Michigan[6]: "The Internet is dynamic; today's 'experiment' is tomorrow's 'production'. ... Prototype or 'experimental' features are often introduced on mainstream or 'production' facilities ... Any effort to cast into law the boundaries between production services and experimental facilities would be obsolete before the ink was dry. ... In the longer term, the telecommunications industry stands to profit immensely ... It would be a shame to see legislation pass in Washington, supported by the RBOCs, that actually hurts the broader American community."

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[5] March 23 "CEO Policy Statement" of 14 major telecommunications companies.

[6] April 7 letter to William Weiss, Chief Executive Officer of Ameritech.

The Computing Research Association has been working with other education and research organizations to develop a clear policy agenda regarding NREN, and we would welcome the opportunity to work together with the telecommunications industry to devise a mutually agreeable framework.

Finally, we would like to bring to the Subcommittee's attention a key application area that is closely related to the Act but not included in it: engineering design. Improving the engineering design process -- our ability to design products and bring them to market -- is critical to restoring America's competitiveness. The area of engineering design is poised for significant advances, because it relies upon the technologies of high performance computing and communications in which so much progress has recently been made. Much of the additional progress required to actually achieve these advances is common to the other HPCC application areas covered by the Act: progress in visualization, network security and privacy, collaborative technology, database technology, improved user interfaces, and so forth.

To summarize our comments concerning H.R. 1757:

- We strongly support the Act, and commend its authors and the Subcommittee for the outstanding job they have done. The Act strives to apply advances in computing in ways that substantively affect all Americans.

- Further advances in core computer science and computer engineering research areas are essential to achieving the goals of the Act. The four application areas identified by the Act build upon the same recent advances (high-speed computing, high-speed networking) and require further advances in the same areas (e.g., user interfaces, intelligent search strategies). The Act has been very well crafted in this regard (among others!).

- Any initiative such as this must be undertaken by a balance of mission-oriented and non-mission oriented agencies. It's important to note, by the way, that the private sector behaves essentially like a collection of mission-oriented agencies in this regard. When the private sector recognizes that a new aspect of computing technology has become important to its mission, it draws upon the basic research community for personnel and results. There are myriad examples of this. *It is critical that there be something to draw upon,* in order to power the *next* round of advances.

- Given the low current level of support for computer science and computer engineering research, particularly within the National Science Foundation, it is critical that new initiatives be supported with new money, rather than "repainting" existing projects or diverting funds from those projects. *Authorization must be followed by appropriation.*

- The idea of demonstration projects is an excellent one: these projects not only will allow the technology to be developed and prototyped, but also will provide a forum for the government and the private sector to consider critical regulatory issues based upon experience rather than speculation.

- We advise caution in legislating distinctions between "production" and "experimental" networks, and restrictions on the use of the latter, at this early stage. The regulatory issues are of course very significant; we fear that a premature attempt to deal with a subset of these issues may inhibit innovation, to the detriment of all.

- We suggest considering the inclusion of engineering design as a fifth application area. Improvements in our ability to design products and bring them to market is critical to restoring America's competitiveness. This application area is poised for significant advances, which will be enabled by the same computer science and computer engineering research agenda required to achieve the goals of the Act's four existing application areas.

I appreciate the opportunity to testify before you on behalf of the Computing Research Association, and once again commend you for your outstanding efforts.

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Edward D. Lazowska

Personal

Born in Washington, D.C., August 3, 1950

Education

Ph.D. in Computer Science, University of Toronto, 1977
A.B. in Computer Science (independent concentration), Brown University, 1972

Recent Employment

University of Washington, Department of Computer Science & Engineering
Professor, Associate Professor, Assistant Professor, 1977-

Digital Equipment Corporation, Systems Research Center
Visiting Scientist, 1984-85

Research Interests

Computer systems: modelling and analysis, design and implementation, distributed and parallel systems.

Representative Recent Grants

National Science Foundation, 1992-96. Co-Principal Investigator (with H. Levy and J. Zahorjan), Grant No. CCR-9200832: *System Support for High Performance Computing*.

National Aeronautics and Space Administration, 1992-95. Investigator (with L. Adams, R. Anderson, J. Bardeen, R. Carlberg, C. Hogan, G. Lake (PI), W. Petersen, and L. Snyder), *Large Scale Structure and Galaxy Formation*.

Washington Technology Center, 1991-93. Co-Principal Investigator (with H. Levy and J. Zahorjan), *High Performance Computing and Communication*.

Boeing Computer Services, 1992. Co-Principal Investigator (with H. Levy), *Distributed and Parallel Operating System Support for Next-Generation Architectures*.

Digital Equipment Corporation, 1990-93. Co-Principal Investigator (with H. Levy), Research Agreement #1076: *Operating System Support for Contemporary Multi-Computers*.

Representative Recent Professional Activities

Member, Technical Advisory Board, Microsoft Research, 1991-.
Member, Board of Directors, Computing Research Association, 1992-; Chair, Government Affairs Committee.
Editor, *IEEE Transactions on Computers*, 1988-.
Program Chair, 13th ACM Symposium on Operating Systems Principles, 1991.
Chair, ACM Software System Award Committee, 1991; Member, 1988-92.
Chair, Committee of Examiners, GRE Computer Science Test, 1986-90; Member, 1982-90.
Chair, ACM Special Interest Group on Measurement and Evaluation (SIGMETRICS), 1985-89.

Student Supervision

12 Ph.D. completed, 20 M.S. completed. Ph.D. graduates in the past five years:

John K. Bennett, 1988 (Rice University)
David B. Wagner, 1989 (University of Colorado)
Brian N. Bershad, 1990 (co-supervised with H. Levy) (Carnegie Mellon University)
Yi-Bing Lin, 1990 (Bell Communications Research)
Mark S. Squillante, 1990 (IBM T.J. Watson Research Center)
Sung K. Chung, 1990 (co-supervised with D. Notkin) (IBM T.J. Watson Research Center)
Thomas E. Anderson, 1991 (co-supervised with H. Levy) (University of California, Berkeley)
B. Clifford Neuman, 1992 (USC Information Sciences Institute)

Key Recent Publications

T. Anderson, E. Lazowska, and H. Levy. The Performance Implications of Thread Management Alternatives for Shared-Memory Multiprocessors. *IEEE Trans. on Computers 38*,12 (Dec. 1989). (Award paper, 1989 ACM SIGMETRICS Conf.)

B. Bershad, T. Anderson, E. Lazowska, and H. Levy. Lightweight Remote Procedure Call. *ACM Trans. on Computer Systems 8*,1 (Feb. 1990). (Award paper, 12th ACM Symp. on Operating Systems Principles.)

T. Anderson, H. Levy, B. Bershad, and E. Lazowska. The Interaction of Architecture and Operating System Design. *Proc. 4th International Conf. on Architectural Support for Programming Languages and Operating Systems* (April 1991).

T. Anderson, B. Bershad, E. Lazowska, and H. Levy. Scheduler Activations: Effective Kernel Support for the User-Level Management of Parallelism. *ACM Trans. on Computer Systems 10*,1 (Feb. 1992). (Award paper, 13th ACM Symp. on Operating Systems Principles.)

Recent Invited Presentations

35 in the past five years, including 9 Distinguished Lecturer Series, Keynote Speaker, or other special event.

Mr. BOUCHER. Thank you, Dr. Weingarten.

Mr. Masi.

Mr. MASI. Thank you, Mr. Chairman, and members of the Subcommittee. I'm quite impressed with the testimony, a summary of the gentlemen to my right. I agree with the major points that they've made.

In my summary I will try to add a few additional points, instead of recovering some of the very good thoughts that they have expressed.

I have been in the high performance computer industry for 13 years, and I was reflecting before coming into this meeting. About 18 months ago I felt that the threat from Japanese computer manufacturers relative to U.S. high performance computing leadership was beyond serious. I perceived the Japanese computer manufacturers to be invincible in this regard. And that was only 18 months ago.

And today I have a completely different outlook. I still hold the very strong companies in Japan—Hitachi, NEC, and Fujitsu—as very serious competitors, but I no longer see them as invincible. I think the high performance computing industry today in the United States in every imaginable way is stronger in terms of competition, in terms of percent of systems that are used around the world created by American manufacturers, and in terms of usage, because I think that the supercomputer, high performance computers are tools, and the value of a tool lies in the using of it.

My comments, additionally, are mostly centered on the status of the high performance computing bill. I have just talked about leadership, which is, as I view it, one of the three goals of the High Performance Computing and Communications initiative of 1991.

The second goal, which is to have widespread dissemination, and comments were made to this a minute or two ago, but with the HPCC has come some cooperation between government labs and universities and, as we have heard, also the private sector that really never existed, to my knowledge, before. It's sometimes difficult to cooperate with those who you might see yourselves competing with. It certainly is in industry, and I imagine it is as well in universities and government. But the cooperation that has existed through consortia like the Concurrent Supercomputing Consortium, Caltech, APL, and a large number of other institutions, the recently formed consortium, National Consortium for High Performance Computing, and the PICS Consortium based at Oak Ridge are just a few examples of the outstanding cooperation that exists. It probably began with the establishment of the National Centers by the National Science Foundation Centers, and I think HPCC has simply added to that, and added to it in a very positive way.

So I would say in terms of wide dissemination there has been a tremendous amount of progress made, realizing now that we are only 2½ years into the HPCC bill.

Further dissemination needs to occur in the private sector, and that gets on to my comments relative to the third objective of the HPCC: improving America's productivity and competitiveness. And here is where I think that at the halfway point in HPCC more needs to be done. Specifically, that means applications. Applications are the means by which the high performance computers are put to use, and if you look at technical computing applications, you find that maybe there is on the order of 50 or so that are widely used. These applications have been developed by very small businesses, many with less than 40 employees. But what is very interesting, if you look at the source, the knowledge within those applications, they come from government and universities. And there are numerous examples that come out of either the government lab or government-funded research at universities.

And, in a way there is a food chain, and the food chain comes from the government lab or government-funded research in the university and feeds its way into the private sector. And there are examples of that that have been discussed at the table here today. I think that needs to be enhanced, and that needs to be enhanced through involving to a greater extent than it has been involved in the past some of these small, independent software vendors who create technical computing applications.

Lastly, on 1757, I think the applications and the expansion of access to HPCC systems or networks is a very good goal. I see HPCC as being the foundation for NII, and therefore the funding and full commitment to see through the program to its successful conclusion is very important. And therefore I would very much want to see an expanded focus supported by expanded funding.

Thank you.

[The prepared statement of Mr. Masi follows:]

Testimony on High Performance Computing and Communications Before the House Committee on Science, Space, and Technology Subcommittee on Science

by Edward A. Masi
President, Intel Supercomputer Systems Division
and
Vice President, Intel Corporation
May 11, 1993

Mr. Chairman and Members of the Subcommittee:

My name is Edward A. Masi. I'm the president of Intel Corporation's Supercomputer Systems Division, and I'm pleased to be here to discuss scalable high performance computing (SHPC). It's an important subject for Intel in three respects: we use high performance computing in the design of our semiconductor devices and fabrication processes, we manufacture scalable high performance computers, and we're an industry partner in the High Performance Computing and Communications Program. Our involvement in the Intel/ARPA Touchstone Project has led to improvements in system design, operating systems and other technologies that are being incorporated into mainstream commercial systems.

Today, I will review the progress that's been made toward reaching the goals of the HPCC program. I believe the biggest remaining obstacle to fulfilling our goals is the lack of applications software, and I'll suggest some steps that will help in that respect. I'll also comment briefly on Chairman Boucher's legislation, H.R. 1757.

Evaluation of the HPCC Program

The High Performance Computing and Communications Act of 1991 grew out of the recognition that scalable high performance computing is essential for addressing the Grand Challenges of science. The Act invited the U.S. government, academia and industry to work together to reach three goals:

- Extend U.S. leadership in high performance computing and communications,
- Stimulate the widespread dissemination and application of HPCC technologies, and
- Spur gains in U.S. productivity and industrial competitiveness.

We're halfway through the five-year program authorized by the HPCC Act, and the payback for the public and private investments generated by the Act is just beginning. I believe the program is on track and that the results achieved demonstrate the validity of the program's approach.

1. Extend U.S. leadership.

When the HPCC Act was passed, U.S. leadership in high performance computing was in jeopardy. The Japanese were targeting the U.S. supercomputer industry, and NEC had just announced a supercomputer that set a new record for peak performance. To their credit, our nation's policymakers chose to defend U.S. leadership by investing in the relatively new approach called scalable high performance computing.

As the attached charts show, this strategy is already helping the U.S. extend its leadership in high performance computing. Eighty-five percent of the SHPC systems installed worldwide last year were built by U.S. manufacturers, and all major U.S. mainframe and supercomputer manufacturers, including Convex, Cray Research, IBM and NCR, have announced plans for scalable systems. The U.S. also leads in using this new technology, with seventy percent of the SHPC systems installed last year going to U.S. sites.

2. Disseminate the technologies.

The HPCC program has led to the formation of numerous consortia whose members are using scalable technologies to conduct Grand Challenge research and to further the development of SHPC technologies.

For example, the Partnership in Computational Science (PICS) Consortium, based at the DOE's Oak Ridge National Laboratory in Tennessee, has brought together experts from three DOE labs and six universities to address the Grand Challenges of ground water transport and remediation, materials science and global climate modeling. The National Consortium for High Performance Computing (NCHPC), which is the largest and most varied HPC consortium, includes dozens of research institutions, universities and industrial partners. Together, they are applying SHPC technologies to technical problems in the airline, automotive, computer, defense, electronics, pharmaceutical and other industries. The Concurrent Supercomputing Consortium has used its Intel Touchstone Delta prototype at Caltech to support computational experiments by more than 50 research teams from 400 institutions.

These consortia, along with the National Science Foundation's National Supercomputing Centers, help ensure that scalable machines are available not only to Grand Challenge researchers but also to the wider educational community. For example, both NCHPC and PICS include programs for primary and secondary school students and teachers.

Technology transfer from the HPCC program is being led by the national labs. Sandia National Laboratories in New Mexico, for example, has more than $400 million in cooperative research and development agreements (CRADAs), over $100 million of which are in industrial computing and applications.

In addition to accelerating the rate of progress in scientific and engineering research, HPCC collaborations are paying benefits in areas such as scalable algorithms, programming environments and operating systems. To give two examples, collaboration between Intel and the San Diego Supercomputer Center (SDSC) has led to the development of resource accounting, control and scheduling software for scalable computers. SDSC is prepared to make this package available to other U.S computer manufacturers. Intel also supported the development of a parallel version of the well-known LINPACK dense equation solver by computer scientists at Oak Ridge National Laboratory and the University of Texas. That software has been placed in the public domain.

3 Spur productivity and competitiveness

Business and industry have been slower to adopt scalable computing than the research community. Consequently, the HPCC program has yet to reach its third objective of increasing U.S. productivity and competitiveness. However, commercial examples clearly demonstrate SHPC's value in many different industries:

- Grant Tensor Geophysical Corp. uses a scalable computer to perform 3-D prestack depth migration, a data analysis technique that took a year or more to run on vector supercomputers. The scalable system provides preliminary results within a few days and final results in about three weeks.

- Prudential Securities uses a scalable computer to predict how a complex financial instrument will perform under various economic scenarios. Using their previous technology, traders had to call clients back with results; with a scalable computer, they can run the simulation and report the answer while the client is still on the phone.

- Lockheed Advanced Development Company has solved what they believe is the largest computational electromagnetics problem ever. Using scalable computers, they can model the stealth characteristics of an entire airplane rather than having to break the model into sections. The new method improves the accuracy of their analysis and the quality of their designs.

Completing the Mission of the 1991 HPCC Act

Commercial users of SHPC systems tend to be large, technology-based companies that have an urgent need for more computing performance as well as the in-house resources to write their own software. Thousands more companies can benefit from SHPC performance, but will not exploit the new technologies until off-the-shelf software is available. So, to complete the HPCC program, we must develop a base of off-the-shelf applications software that works on a range of scalable computers -- from supercomputers to workstation clusters.

While market forces will eventually lead to scalable application development, I believe the nation's need for high performance computing is too pressing to be left exclusively to the marketplace. This is an area where relatively modest government investments can be multiplied by industrial and academic contributions.

The development of technical applications software is something of a cottage industry, with many companies having little expertise in scalable programming methods. In addition, the lack of software portability has made it difficult for application developers to realize an adequate return on their investment. As a result, few commercial software providers have begun the task of restructuring older, "sequential" applications to run on scalable computers.

To address this situation, I recommend the Committee consider three actions:

1. Involve independent software vendors (ISVs) in developing scalable applications.

I would like to see the HPCC program actively engage and assist ISVs in developing applications for SHPC systems. This activity will spread the benefits of scalable computing into business and industry, and will also help continue U.S. leadership in software applications.

In keeping with the philosophy of the HPCC program, this outreach program should be structured as a series of collaborations among ISVs, computer manufacturers, national labs and "lead users" from industry. In addition to the direct assistance and manpower that national lab scientists can provide, much of the parallel software technology developed at these facilities should be packaged in the form of highly tuned software libraries and made available to the software community at large. Some of this library work is already occurring, but needs to be further coordinated and encouraged. Industrial "lead users" can be encouraged to test and validate the new software in a production setting.

2. Promote software application standards.

There are many different SHPC system architectures, and until recently, software developed for one high performance architecture had to undergo major changes to run on a different one. Now, new technologies are becoming available that simplify this process. For example, PVM, which was developed at Oak Ridge National Laboratory, allows a single application to run with relatively few changes on an Intel Paragon™, a Thinking Machines CM-5 or a collection of networked workstations. The HPCC program can and should take an active role in promoting software inter-operability and high-level environments for scalable systems. This will encourage software development by enlarging the market for scalable applications and stimulating further investment in SHPC technologies.

3. Continue to provide broad access to scalable systems.

Although networked access to large high performance computers is important, small, local SHPC systems are also desirable because they help create a "culture of scalable computing." With constricted budgets, however, many small and mid-sized colleges that would benefit from having an SHPC system cannot afford one. Providing the funding support for these sites to obtain small scalable computers is an economical way to encourage software development and ensure that tomorrow's workers are trained in scalable computing methods.

Comments on H.R. 1757

Chairman Boucher's legislation, the High Performance Computing and High Speed Networking Applications Act of 1993 (H.R. 1757), is a praiseworthy proposal to expand upon the High Performance Computing Act of 1991. I'm especially pleased that H.R. 1757 strengthens FCCSET's administrative responsibilities over the HPCC program. I also believe the bill is absolutely correct in its emphasis on applications, particularly the inclusion of database applications, which will support the use of large national databases on scalable computers.

In addition to these general comments, I'd like to offer three specific recommendations:

1. Ensure that incremental funding for H.R. 1757 is forthcoming.

The current HPCC program establishes the foundation on which many of the networking and computing demonstrations projects cited in H.R. 1757 will rely. Therefore, we must take care that our eagerness to undertake the new projects identified in H.R. 1757 does not get in the way of completing the original HPCC mission. If we expand the focus without expanding the funding, HPCC will not be successful and the foundation for NII will not be in place. Congress must ensure that additional funding to support the new goals of H.R. 1757 is truly forthcoming.

2. Strengthen the administrative oversight and aim for greater involvement from industry.

Many public and private institutions that could benefit from the HPCC program, as well as contribute to it, have found it difficult to stay informed about the government's HPCC activities. We've seen a great deal of improvement since Dr. Lindberg came on board to direct the HPCC National Coordination Office. The information sharing meetings held in Pittsburgh last Friday are an excellent example of the positive steps he is taking, and we hope to see more of these.

I also suggest that the HPCC Advisory Committee play a stronger administrative role, ideally with semiannual joint meetings with FCCSET and clear deliverables, such as annual reports that critique the HPCC program. I would also recommend that the Committee consider how large the Advisory Committee can be and still provide effective leadership in high performance computing policy. Because HPCC technologies are evolving so rapidly, the Committee must maintain a core of advanced users and HPC technologists.

3. Plan for wireless computing as an integral part of the NII.

One of the goals of H.R. 1757 and the National Information Infrastructure is to provide universal access to the benefits of high performance computing. Wireless or mobile computing is important to accomplishing this; it's also a rapidly emerging international market in which the U.S. must be competitive.

Providing wireless access to the resources of the NII will require new concepts for interconnectivity and network operating systems, to ensure full upward and downward interaction between hand-held devices and large databases residing on SHPC systems or on other networked computers. I would therefore encourage the Committee to incorporate wireless network access into NII development and demonstrations.

In Conclusion

In these post-Cold War times, there's considerable concern over how to refocus the national research community and to transfer technology from the defense labs to industry. Upon reflection, one of the key contributions of the HPCC program has been to provide a model of how such a process can take place. Through collaboration, expertise in the national laboratories, universities and business community have been brought together to work effectively on Grand Challenge problems of science. This renewed focus on HPCC applications promises even greater technology transfer potential.

Application collaborations directly engage the labs in problems that enhance U.S. industrial competitiveness -- and they also produce software. I can think of no better way to capture and retain intellectual property than through the development of software applications and tools. The technology transfer vehicle itself is both a library of expert information and a tool for solving problems.

To sum up, I would say that HPCC is not yet at the ignition stage, but the energy is building. The government agencies, the national research community, the educational establishment and the SHPC vendors have made significant progress toward the goals laid out in the HPCC Act of 1991. The challenge now is to focus on software applications. If we do that successfully, we have an exciting opportunity to spark the new era of high performance computing that the initiators of the HPCC Act set out to create.

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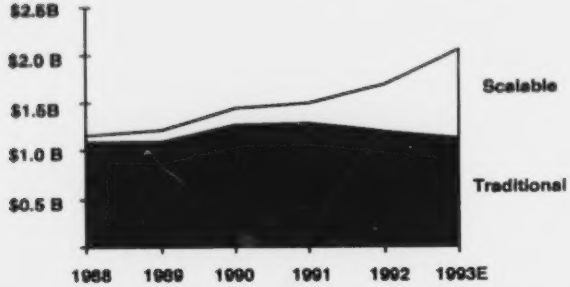

Figure 1. Worldwide Revenue: Traditional vs. Scalable Supercomputers

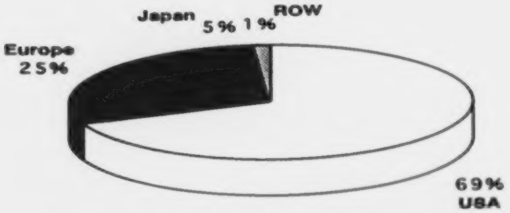

Figure 2. Scalable Supercomputer Installations by Country: Share of 1992 Worldwide Revenue

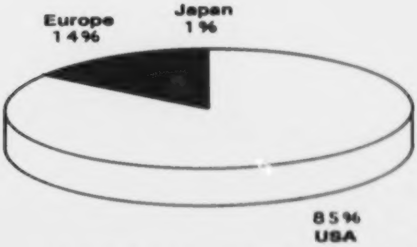

Figure 3. Scalable System Manufacturer's Country of Origin: Share of 1992 Worldwide Revenue

Source: InfoCorp

Edward A. Masi
President and General Manager
Intel Supercomputer Systems Division

Vice President
Intel Corporation

Edward A. Masi is President and General Manager of Intel Corporation's Supercomputer Systems Division, the nation's market-share leader in scalable high performance computing. Mr. Masi is responsible for all division operations, including product development, manufacturing, sales, marketing, finance, and international operations.

A 25-year veteran of the computer industry and a well-known figure in the high performance computing community, Mr. Masi joined Intel in March, 1992. He previously served 12 years at Cray Research, where he most recently was executive vice president of sales, service and marketing. Prior to his Cray Research experience, Mr. Masi held a variety of sales management positions at IBM Corp.

Mr. Masi is a 1969 graduate of Tufts University with a degree in mechanical engineering.

Mr. Boucher. Thank you very much, Mr. Masi.

Mr. Kalb.

Mr. Kalb. Mr. Chairman, and members of this distinguished Subcommittee, my name is Jeff Kalb. I am the President and Chief Executive Officer of MasPar Computer Corporation, a leading manufacturer of massively parallel computer systems, based in Sunnyvale, California.

My detailed comments have been submitted in writing, and this morning I would just like to comment on a few of the major points.3

First of all, the Committee is to be commended for the leadership role it has played in advancing American preeminence in high performance computing and communications to date, and for its foresight in considering new initiatives to further advance the Nation.

As we move into the 21st century, we will experience ever-increasing global competition across our existing industry sectors, and advances in technology will yield completely new products and services designed for the world market. Product life cycles are shortening, and the time required to win or lose in major markets is decreasing.

The currency of this competition is not bushels of grain, tons of steel, barrels of oil, or even miles of railroad track as in other years, but knowledge and data. Within that setting, those nations with the best information technology infrastructures will dominate emerging markets. By investing today in the United States technology infrastructure we will create the foundation for the high value-added, high wage jobs we must have if we are to maintain our standard of living.

As a firm believer in America's free market system, I am cautious about advocating government involvement in anything. Having said that, the simple explanation for my support of the initiative is the time urgency associated with developing the infrastructure. By continuing to invest in the HPCC program, the government buys an acceleration of the development. While some would like to think that any government involvement is always bad, there is little question in my mind that government investments in advanced agriculture, aircraft, electronics and biotechnology, to name a few, have helped the United States attain leadership positions in these markets.

In this case there is an added requirement that effective use of these technologies will require some major training and education, and these are roles which we typically assign to the Federal Government or the State governments. We are already beginning to see glimmers of the potential benefits that dramatically improved computations and communications capabilities can provide. Using my own company's massively parallel computers, NASA Goddard has been able to restore Hubble Space Telescope images, discovering some new solar structures in the process.

They have trained almost a hundred scientists in programming massively parallel computers and developed techniques for simulating fluid flow for large aircraft designs. DOE's Ames Labs has developed new methods for photo-realistic scene rendering so that future architects and designers can simulate the look of their designs. They have developed software technology for non-destructive testing of materials and finished products, and along the way they trained 100 high school students to program massively parallel computers via their Women in Science and Engineering Program.

The National Cancer Institute uses our systems in human genome sequence searching and large-scale molecular structure simulations to assist in the effort to find cures for cancer and AIDS. And in what I believe is the first large-scale deployment of massively parallel computers stimulated by the high performance computing activities, the Raytheon Corporation will be using our systems in the next generation over-the-horizon ground-based radar systems. In the process they will reduce the associated hardware and software life cycle costs by as much as 90 percent, making the system more adaptable in the process.

But the real benefits are only beginning, and before we can see widespread deployment there are some challenges we must address. One of these is already being addressed by H.R. 1757, and that is the need to move to a greater applications focus. The "Grand Challenges of Science" has been a useful rallying cry to discuss the development of the largest and fastest systems. But if we are to see these technologies diffused into the infrastructure, then the focus must include a much larger and broader applications orientation and the fostering of the use of systems which are oriented to cost-effectiveness and ease of use. We need a new rallying cry to reflect this modified change.

A second issue only partially addressed in H.R. 1757 is the need for enhanced management of the program. This is a tough one. The Federal Government is organized by agencies and missions, while this program requires a lot of cross-agency coordination to maximize effectiveness. Besides moving forward quickly to establish the High Performance Computing Advisory Committee specified in the original legislation, I believe that the new legislation should require the development and maintenance of a technology road map along the lines of one recently created by the Semiconductor Industries Association under the leadership of Gordon Moore. Such a road map would identify the key technologies and problems which must be mastered over the next 10 years. Parties wanting to participate in the program would then have an idea as to the contributions needed. Not all projects have to follow the road map for it could never anticipate all needs. But such a plan combined with the greater establishment of project goals and more reporting on accomplishments and progress would give much greater structure and effectiveness to the program.

Finally, and by no means least important, I would like to caution against too much fixation on the data highways themselves. The highway analogy is a good one because it evokes images of the impact the Interstate Highway System had on improving our country. But it is worth remembering that not only was such a system previously demonstrated by the German autobahn system of World War II, but the cities to be connected already existed and we knew what kind of traffic to expect.

Electronic data cities do not exist, and, at least for the parallel computers which will be necessary for high speed data access, even sufficient numbers of programmers don't exist. So I would recommend that the final legislation for H.R. 1757 contain specific programs for stimulating the training of a large number, perhaps 50,000, data parallel programmers over the next 5 years. And a sizable portion of the program needs to be directed toward the use of those parallel programmers to provide the data repositories and analysis capabilities that our electronic motorists of the future will require.

In closing, my company strongly endorses the intent and programs associated with the High Performance Computing Act of 1991 and its proposed amendments outlined in H.R. 1757. We believe that by expanding the vision of HPCC a broader industrial opportunity is emerging that can have a much greater impact on the economic health of our Nation than the current initiative.

Thank you very much.

[The prepared statement of Mr. Kalb follows:]

MasPar

Statement of
Mr. Jeffrey C. Kalb,
President and CEO
MasPar Computer Corporation

On the High-Performance Computing Act of 1991

and H.R. 1757

The High Performance Computing and High Speed
Networking Applications Act of 1993

Before the

Subcommittee on Science
of the
House Committee on Science, Space and Technology

May 11, 1993

MasPar Computer Corporation
749 North Mary Avenue Sunnyvale California 94086 [illegible]

Mr. Chairman and members of this distinguished committee, my name is Jeff Kalb. I am the President and Chief Executive Officer of MasPar Computer Corporation, a leading developer of massively parallel computer systems and associated software, based in Sunnyvale, California. My company is a participant in the High Performance Computing and Communications Program, and as such, I welcome the opportunity to speak to you today.

Introduction

Mr. Chairman, I appreciate the opportunity to contribute to your hearings on the implementation of the High-Performance Computing and Communications Act of 1991, and my views on its proposed amendments outlined within H.R. 1757. The Committee is to be commended for the leadership role it has played in advancing American preeminence in high-performance computing and communications to date, and for its foresight in considering new initiatives to further advance the nation. We support the near-term action of Congress on these issues vital to American leadership in a wide range of technologies.

As we move into the 21st century, we will experience ever-increasing global competition across our existing industry sectors, and advances in technology will yield completely new products and services designed for the world market. Product life-cycles are shortening, and the time required to win or lose in major markets is decreasing. The currency of this competition is not bushels of grain or tons of steel, or even miles of railroad track as in other years – but knowledge and data. Within that setting, those nations with the best information technology infrastructures will dominate emerging markets. Once an advantage is established by others, it will require an even larger investment to recapture the lead. By investing today in the United States' technology infrastructure, we will lay the foundation for the high value-added, high-wage jobs we must have if we are to maintain our standard of living. My company, as well as others in the computer industry, is eager to work with the Congress and the Administration to develop a policy and program that will ensure American industrial leadership in the '90s and in the 21st Century.

I. Assessment of the High Performance Computing and Communications (HPCC) Act of 1991

Program Contributions to Date

The High Performance Computing and Communications Act of 1991 has already made a significant contribution to American leadership in advanced computing and communications, and it will provide a strong foundation for the upcoming National Information Infrastructure Program. We believe the program should be fully funded, and with an expanded charter, we would support expanding the program funding.

The High-Performance Computing Act has already made several key contributions:

- Establishment of a national goal and improved program and policy coordination between federal agencies involved in high-performance computing and communications
- Acceleration of the development of HPCC technologies, especially massively parallel systems required to solve the most compute-intensive problems
- Advancement of America's high-performance communications networks
- Improved collaboration between government, academia, and industry on formulating U.S. technology policy

In the case of my company and our customers, there have been several notable examples of what has been achieved through the HPCC program – and these are only a small fraction of the Program's overall contributions:

NASA Goddard Space Flight Center

In the last three years, NASA Goddard has made a number of impressive contributions through their work in the application of massively parallel systems technology to many critical challenges of science today, including:

- Restoration of blurred Hubble Space Telescope Images
- 90 scientists trained in programming massively parallel computers
- Computational fluid dynamic simulations for very large data sets

DOE Ames Laboratory

Ames Laboratory has also been a pioneering site for MasPar and other massively parallel computer systems. Some of their contributions include:

- Trained over 100 high school students in massively parallel computing and programming via their "Women in Science and Engineering" Program
- Developed a new method for photorealistic scene rendering which will help architects and product designers fully simulate the "look" of their designs.
- Developed software technology for nondestructive testing of raw materials or finished products. Examples would include scanning aircraft to find hairline fractures or other defects or scanning railroad tracks for any minute defects before they are laid.

The National Cancer Institute

The National Cancer Institute (NCI) is also employing massively parallel computing in its battle against cancer and AIDS. A few of their achievements within the program include:

- Human Genome Sequence Searching
- Large-scale molecular structure predictions/simulations to assist in the effort to find cures for cancer and AIDS.

With the increased computational power of massively parallel computing, NCI can simulate much larger molecular structures and manipulate the AIDS virus' genetic structure.

These are only few members of the research community that are 1) advancing science, and 2) developing critical technologies that can and will be used to advance American industry today. And this has been made possible through the the HPCC Initiative.

Ideas for Improving Program Implementation

There are many important achievements that will provide the foundation for our HPCC and National Information Infrastructure Initiatives. However, I believe there is significant opportunity to dramatically improve the effectiveness of the Program through more improved organization, and even closer collaboration between government, academia, and industry. Below please find four areas we would recommend to focus upon:

1) Creation of an HPCC/NII "Roadmap" and Rallying Cry

Given the scope and long term nature of the HPCC/NII Initiatives, I would strongly recommend the development and maintenance of a multi-year "Technology Roadmap" for the initiative, similar to the one recently created by the Semiconductor Industry Association (SIA) under the leadership of Gordon Moore. This effort could be lead by the Office of Science and Technology Policy, and involve the implementing Departments/Agencies, Academia, and concerned representatives of industry. Once the Roadmap is in place, it becomes much easier to assess program proposals, as they can all be measured against their contribution to the higher-level vision.

The other critical element I would suggest is a major rallying cry for the effort. Americans tend to do their best work in times or crisis or through great challenges. Classic examples include our efforts during World War II, "Man on the Moon by the end of the decade", and Desert Shield/Storm. The challenge facing the nation today is an "Economic War" that doesn't provide the obvious enemy or challenge provided by these other national pursuits. But the long-range implications are just as critical for the health and wealth of the nation.

2) Specific goals, objectives, measures, and ongoing management of HPCC programs

Building on the "Roadmap" concept outlined above, we believe the objectives of the HPPC Act can be better supported through more specific goal setting, measures, and management of the HPCC program.

Recommendations:

- The HPCC Coordination office has limited power and resources to 1) arbitrate conflicts between program participants, or 2) provide substantial program information to the private sector. I believe the Act will be better served if the office was chartered with the authority to provide leadership for the program, as well as to drive the accountability of the various programs, and foster private sector partnership in the pursuit of program goals. The individual departments and agencies can still drive their own programs, but there should be upfront integration and sharing – and all groups should be measured against their goals.

- There should more detailed annual plans which go beyond the HPCC "Blue Book" in outlining the annual agenda for the various players within the program. Each group's accomplishments versus plan should be assessed annually, with more resources accruing to those who deliver the most substantial results. Particular weight should be given to those who are leveraging the technology into near-term industrial leadership, through test beds, proof of concept applications development, and the training of skilled personnel. Examples of such metrics include:
    - Number of application test beds targeted and delivered by given dates
    - Number of application development engineers trained by given dates
    - Number of new business activities (new and existing enterprises) initiated due to HPCC Programs
    - Specific results achieved through investments in hardware, software, and other HPCC technologies

3) More collaboration between government, industry, and academia

An important – but ignored – aspect of the High Performance Computing Act of 1991 is the required Presidential establishment of The High-Performance Computing Advisory Committee. We believe such an advisory body is fundamental to ensuring a high level of collaboration between government, industry, and academia. We believe the Committee's absence has impeded the progress of the HPCC initiative and it should be established as soon as possible.

Recommendations:

- Work with the Office of Science and Technology Policy to immediately establish the High-Performance Computing Advisory Committee.

- Establish an annual conference of government, industry, and academia to review the previous year's results achieved versus objectives, and to establish joint objectives for the coming year. This would ensure maximum collaboration between all parties empowered to advance the initiative.

- Create an HPCC information clearing house for information dissemination and collaboration.

4) Need for Increased focus on the "Grand Challenges of Industry and the Nation"

The new focus on applications of HPCC technology contained within H.R. 1757 represents a major step toward leveraging this leadership technology into industrial advantage for our nation. The most important economic benefits of HPCC and the National Information Infrastructure (NII) will come as we leverage these technologies out into industry. Given that there is widespread understanding that the battle we face in the coming years is based on industrial leadership, we would encourage our world leading scientists and engineers to 1) focus on industry's "Grand Challenges", and 2) develop a world-leading information infrastructure.

Summary Assessment of the Act

While there remains room for improvement in the HPCC Act, we view it as a tremendous contributor to our nation's leadership in these critical technologies. The foundation laid over the last two years will provide an excellent base for the follow-on work outlined in H.R. 1757, and we look forward to working with all concerned parties to make the next phase of the program an even bigger success.

II. H.R. 1757: The High Performance Computing and High Speed Networking Applications Act of 1993

Section 1: Executive Summary

Mr. Chairman and esteemed members of the Committee, I would like to initiate my discussion of the Bill by stating my firm support for the legislation. We believe the existing HPCC Act has made major contributions to American science and industry. Our position has consistently been to move more of the effort into applications that can contribute to the industrial leadership of the United States, and the proposed legislation would advance this agenda significantly. This represents an important step in the evolution of the HPCC Initiative toward solving the computational and communications problems of a broad range of Americans. The greater the focus on "real" problem solving, the greater the national benefits that will accrue from our leadership in high-performance computing and communications.

Let me state clearly that I believe that the proposed amendment represents solid legislative work. As a businessman, I would prefer to see many more specifics on the goals, objectives, milestones, and metrics for the work of the various players. But I understand well that it is not the intent of legislation to deal with all of the details associated with its implementation, and we must rely on the commitment and skill of the Executive Branch to ensure the overall program is well managed.

Summary Point 1:	H.R. 1757 Needs Stronger Language on Education For High-Performance Computing

The one area where I would recommend stronger legislative language is on the development of the "human capital" required to develop the software required to deliver on the promise of the National Information Infrastructure. A relatively simple goal I would propose would be "50,000 Parallel Programmers by 1998." We will not be able to achieve any of the Program's higher-level objectives if there is not a dramatic increase in the number of programmers skilled in parallel applications development.

Summary Point 2:	Focus on Successful Completion of Projects

It is important that this effort does not become diffused by trying to be all things to all people. In order for NII to succeed, it is critical that projects be implemented using a phased approach, ensuring the successful completion of each project — rather than initiating too many efforts simultaneously. As is outlined throughout my Statement, there are many technical and financial challenges associated with delivering on the promise of NII, and we will not be well served if the program becomes over-politicised and spread too thin.

Summary Point 3: The Government Should Invest in NII to Accelerate Infrastructure and Market Development

By accelerating the development of a robust information infrastructure, we can take a leadership position in many high-growth, information-dependent businesses of today and tomorrow. This will create jobs and wealth for the nation, and thereby make a major contribution toward advancing our standard of living.

As a firm believer in America's free market system, I am cautious about advocating government involvement in anything. Having said that, the simple explanation for my support of the initiative is the time urgency associated with developing the infrastructure. The data highways themselves will likely be largely funded by private enterprise – if the regulatory bodies enable the telecommunications industry to profitably advance into the 21st century. As the information infrastructure starts to develop, existing businesses and budding entrepreneurs will deliver new products and services based on this new technology. By continuing to invest in the HPCC program, what the government buys is an acceleration of the development. While some would like to think that any government involvement is always bad, there is little question in my mind that government investments in advanced aircraft, electronics, and biotechnology – to name a few – have helped the U.S. attain a leadership position in these markets. In this case, there is an added requirement that effective use of these technologies will require some major training and education, roles which we typically assign to the government.

Section 2: Understanding the True Opportunities and Issues of NII

Having outlined my high-level view of the initiative above, I wish to provide support for my position and to highlight some of the critical issues associated with delivering on the promise of NII. Any investments the government makes should be carefully considered and implemented, with ongoing metrics to assess whether investments should be continued. My hope is that this information will prove helpful as the Committee moves forward with the debate on the initiative.

I have organized my observations into the following topics:

I. A Businessman and Technologist's View of the Broader Opportunity in the NII

II. The Massively Parallel Systems Business:
One Example of the Potential Job Growth Through NII "Seeding"

III. Building "Data Cities" and not "Data Highways" is the True Challenge

IV. 50,000 Parallel Programmers by '98

V. Successfully Implementing the Program

I. A Businessman and Technologist's View of the Broader Opportunity in the NII

If the U.S. is to maintain or advance its leadership in science, technology, or education, we must broaden the HPCC initiative. By combining the forces of government, industry, and academia, I believe we can aggressively move forward to exploit the high speed networks and the computers required to deliver on the promise of NII. When implemented, a national information superhighway and supporting solutions will dramatically change the way we conduct basic research, design and produce consumer products, and conduct life-long learning – to name just a few contributions. The complete benefits to the nation are impossible to calibrate today. But there is little question that our leadership in almost all disciplines will be advanced by – if not dependent upon – this initiative.

Information technology plays a critical role in almost every industry and service business. The leading companies in business ranging from clothing manufacturing to banking, pharmaceuticals, retail, and automobiles owe a significant part of their success to their innovative use of information technology. With the advent of electronic information infrastructure, we can enable such industries to further advance their leadership positions in our new global economy.

HPCC Technology for Economic Leadership

The computer industry growth is but one part of the potential impact of lower-cost, high-performance computing. The real impact accrues to the new users who can develop better products and services by solving problems previously beyond their means.

A very good example of the need for high-performance computing at much more affordable price points is provided by MasPar's experience working with Motorola. Motorola believes that in order to be globally competitive in the year 2000, they must reduce product development cycle times by 90%. In order to achieve this objective, company executives believe they will need to use massively parallel computers to simulate the entire product, from semiconductor devices to product packaging to the manufacturing process. This would eliminate the traditional prototyping process, and result in quality finished products ready for customer consumption when the design is first completed.

Dual-Use Technology to Reduce Compute Costs by 90%

An example of the pending maturation of MPP technology stimulated by HPCC efforts is provided by Raytheon's use of my own company's systems for their new Ground-Based Radar System. Instead of developing proprietary military specification hardware for the system, Raytheon will be using Commercial-Off-The-Shelf (COTS) MPP technology on a globally deployed system. The net effect of this decision will be to reduce the lifecycle cost of the computational engine and software of the Radar system by as much as 90% – while making the system more adaptive to future, unforeseen requirements.

II. The Massively Parallel Systems Business: One Example of the Potential Job Growth Through NII "Seeding"

While there are many emerging business segments that will benefit from the NII Initiative, let me try to put some perspective on what I see as achievable just within the emerging massively parallel systems business in which my company participates. Specifically, we believe that advances in the cost-effectiveness of high performance computing availed by the use of affordable massively parallel computing technology can enable thousands if not millions of commercial customers to benefit from this technology in the coming years. If the proper investments in software and systems infrastructure are made by the government in the next few years, American industry will be able to successfully exploit affordable massively parallel processor (MPP) technology to develop and bring to market products ranging from automobiles to pharmaceuticals to jet aircraft to semiconductors more quickly than our international competitors. This would result in sustainable advantages over our global competitors in numerous industries for many years to come. In the computer hardware, software, and services businesses alone we believe a robust massively parallel systems and communications business can create 84,000 highly skilled jobs by the year 2000, and contribute $12 Billion to our GDP. Additionally, the financial benefits and the job creation/retention delivered to other industrial segments would be much more significant.

III. Building "Data Cities" and not "Data Highways" is the True Challenge

While the "Data Highway" is a good metaphor for helping the broader community conceptualize what the NII is, it also serves to over-simplify the undertaking. What made the interstate highway system valuable to the nation was the existence of cities or other desirable destinations. In order for the data highways to deliver comparable value to the nation, much effort needs to be invested in developing "Data Cites," or large storehouses of valuable information. Today, if we provided a nationwide, high-speed fiber optic network, there would be few information/entertainment "products" available to exploit the resource.

And this problem isn't just the lack of a business opportunity, but the computational hardware and application software to translate huge datasets into useful information to be transferred over the network.

"Data Cities" Explained

A specific example of a "Data City" might be some significant percentage of the Library of Congress accessible in an electronic form, coupled with the application toolset to enable users to quickly access the particular information they need. Today, only a small percentage of the Library of Congress is electronically accessible, and the data extraction tools required to comb through gigabytes or terabytes of data in search of useful information are simply not available. Below is a layered view of the technology required for a "Data City" that could service this application:

"Data City" Needs	Technology Required
Friendly User Interface	Graphical, point-and-select interface
Application Software	End-user applications designed to solve a particular problem
Database Query SW	Application tools to manage queries across large, distributed databases
Database	New database technology to accommodate extremely large distributed databases
Operating System SW	Extensions to industry standard OS for high-speed, high volume transactions
Foundation Hardware	Massively parallel computers, high-speed networking, affordable high-performance data storage

As you can see from this basic hierarchy of technology, there is much more to the development of the NII than the "last mile" of fiber to each household in America. Thus, the focus of the early stages of this undertaking needs to address the entire range of solutions technology required to solve some group's meaningful problem. I would also encourage focus in the applications testbeds on a small number of specific technologies, and then leverage these developments across the emerging infrastructure.

The Electric Power Grid Analogy Applies

I appreciated the April 17, 1993 Statement before this Subcommittee of Dr. Richard F. Rashid, Director of Research at Microsoft. His reference to household appliances and their "value creation" role for electricity is a good one. I would only build on his comments to say that the development of the infrastructure to deliver the electricity to the 110V outlet is illustrative of the challenge. There are very sophisticated power plants and substations that are fundamental to making the high-voltage copper wire deliver any "value" to the households of America. It's appropriate to think of the "Data Cities" outlined above as the power plants and substations that will generate the "value" that can be distributed over the fiber data highway.

IV. 50,000 Parallel Programmers by '98

Throughout history, mankind has advanced itself through knowledge. From the Ancient Mesopotamians to the Greeks and Romans, through to world leaders in modern times, economic leadership has been founded upon leadership in education.

The key to developing a National Information Infrastructure that delivers on the promise for individuals, their communities, and industry will be the development of a new generation of computer programmers that can write client/server and data-parallel software. While H.R. 1757 is appropriately focused on applications, the training of the software development engineers that will produce these applications is a much more fundamental step. The availability of tens-of-thousands of well-trained parallel software development engineers is a requirement for any follow-on HPCC or NII initiatives.

The National Science Foundation could help implement such a broad-based program. They are already providing this in a limited form with infrastructure grants and professorship funding. Such grants should be tied to the requirement that engineering and scientific undergraduate and graduate curricula require parallel programming coursework. By so doing, within a few years, the U.S. would be the dominant supplier of highly-skilled parallel programmers. Such a lead in "Human Capital" will create a tremendous range of new information processing solutions that will advance many different industries – at rates faster than our global competitors.

Many defense engineers and scientists who are currently being displaced as a result in the declining defense budget would also make excellent parallel software development engineers and managers. Retraining is fundamental to transitioning these workers into this emerging industry. We would encourage efforts to assist these workers in transition to this and other emerging technology businesses in the coming months and years, rather than training them for "existing" careers for which there are already too many applicants.

V. Successfully Implementing the Program

There were a number of strong proposals outlined in the proposed legislation, so I will only provide a few observations on how a partnership between government, academia, and industry should go about implementing the program.

1) Utilize Private Enterprise Wherever Possible

The private sector should be incented to make the major investments in the NII wherever possible. We believe that the nation will be best served through private enterprise initiative on the network, with vehicles to ensure universal access. My bias is toward a government role which is focused on seeding new technologies, helping to set industry standards, building the educational infrastructure, and then allowing private enterprise to produce a myriad of exciting new products which solve economically compelling problems for a wide range of customers.

2) Implement Step-By-Step – with a bias toward enhancing competitiveness

Within the four targeted applications areas, the testbed implementation programs should move forward with a focus on maximizing the contribution to American competitiveness. Testbeds should employ technologies which can be transferred broadly throughout the public and private sectors in the near term. That translates into a focus on affordable technologies that will be easily transferable into industry very quickly.

3) Lead the Development of Industry Standards

In order for a National and International Information Infrastructure to deliver on the promise, there is much work that remains to be done in the area of industry standards. Whether it be the format of very large data large data files, or a standard interface for complex database queries, there is much foundation work that needs to be completed. It is important that this effort be integral to the testbed efforts outlined in H.R. 1757, or we may find much of that investment wasted as we try to leverage the work more broadly.

4) Ensure Goals, Objectives, and Measures for All Participants

This issue was already addressed earlier in my Statement, but it is worthwhile to reinforce the message here. I strongly support Section 304 of the Bill which recommends the creation of the "Coordinator of the Program" under the Director of the Office of Science and Technology Policy. There is a need for more communication of program objectives, strategies, plans, and specific results, and such an position should help facilitate the information development and communication. I would also recommend the use of the Technology Roadmap is vehicle for program management wherever practical.

It is also important to ensure there is enough information flowing to industry to ensure broad-based participation in the initiative. As I outlined above, we will do best by stimulating the creativity of American industry and budding entrepreneurs to develop innovative new products that exploit our leadership in high performance computing and communications.

In Closing

My company strongly endorses the intent and programs associated with the High-Performance Computing and Communications Act of 1991, and its proposed amendments outlined in H.R. 1757. We believe that by expanding the vision of HPCC, a broader industrial opportunity is emerging that can have a much greater impact on the economic health of our nation than the current Initiative. We are anxious to work with both Congress and the new Administration to help leverage high-performance computing and communications technology into enduring leadership for American science and industry.

Mr. **Boucher**. Thank you very much, Mr. Kalb.

Dr. Lindberg, we will be pleased to hear from you.

Dr. **Lindberg**. Thank you, Mr. Chairman, and members of the Subcommittee. Thank you for inviting me to speak before the Subcommittee about H.R. 1757, the High Performance Computing and High Speed Networking Applications Act of 1993.

Within the past year, the HPCC program and its participating agencies have pursued the scientific Grand Challenge tasks and certain other scientific problems. The legislation this committee has proposed would go farther. It would expand the program into important application areas. We welcome the bill's focus on application and the national information infrastructure. We believe these represent important and appropriate components of HPCC.

As the President's Science Adviser, Dr. John Gibbons, testified before this subcommittee on April 27, HPCC is a key part of the foundation upon which the advanced National Information Infrastructure will be built. The HPCC has developed computer and communication technologies that have great relevance through applications such as health care, education, manufacturing, digital libraries, and the storage and dissemination of government information. To this end, the HPCC program has recently added a new component, Information Infrastructure Technology and Applications, to its basic organizational structure.

HPCC commenced formally with the fiscal year 92 Federal budget. The program was managed at the level of individual agencies and cross-cutting working groups before the National Coordination Office was established in September of 1992. Previously, however, all 10 participating Federal agencies decided they wanted central management services and endorsed creation of a Coordination Office. The NCO coordinates HPCC programs across Federal agencies. It acts as a liaison to industry, universities and the Congress. And it provides information and communications about HPCC to these and to the public.

Four working groups meet regularly to coordinate the HPCC initiative in areas related to the program's original four components. These are high performance computing systems, advanced software, technology and algorithms, basic research and human resources, and the NREN—the National Research and Education Network.

The structure for the management of the fifth component, information infrastructure and technology applications, and its eventual relationship with the four existing components is being developed in detail now. I can give further information on the management and response to questions, and more is contained in the written testimony.

Mr. Chairman, you asked me to report on HPCC achievements I am personally proud of. In my opinion, one of the major achievements of HPCC so far is the size, complexity and reliability of the NREN Internet high performance communications system. Two years ago the number of users of the present data network, Internet, was estimated at about 100,000. Today, there are, perhaps, 10 million users, and one of the speakers suggested even 15. There are more than 1½ million computers on the Internet. That is an actual number—the other is an estimate—and almost 10,000 networks, and again that is an actual number.

Internet has developed far more rapidly than ever predicted and has proven to be a stable, secure means of communication for a vast span of research and education users.

The second major accomplishment I cite for the HPCC program is its contribution to the many efforts that have produced workable, scalable parallel computers with varying alternative architectures that are actually competing with traditional computers in the marketplace on the basis of price and performance. Three additional American manufacturers joined this activity in the past 2 years.

A third major accomplishment is that there is one high performance network project within the Federal Government. This may seem like an obvious development, but I believe it is not. I believe that without the HPCC project and the OSTP FCCSET governing mechanism one would very likely have four, and perhaps as many as six or seven, large-scale high performance computer networks being built by individual Federal Government departments. That they have contained their enthusiasm for this technology and have, so to speak, sublimated their design principles to accommodate common goals is a tribute both to the high quality of the employees and a tribute to the coordinating mechanisms that were provided by OSTP FCCSET.

The incorporation of virtual realities technology into the HPCC program is a fourth major accomplishment. This work came along considerably faster than many thought possible. I am proud that the HPCC group welcomed this technology as part of the Information Infrastructure Technology and Applications.

Mr. Chairman, you also asked me to note the lessons learned. Through the NCO experience, I have learned that there are excellent, reliable and self-motivated people from all 10 Federal Government agencies and units. These people have a surprising tolerance for the efforts required to adjust common goals to satisfy the numerous agency mission requirements. This takes the form of nights and weekends, I might add. I very much admire their efforts and contributions.

Secondly, I have also learned that there is a real need for conscious application of ordinary management systems and principles for the operation of this complex HPCC project; that is, brilliant design is not enough. The work of the government also requires careful planning, documentation, consensus building, and formal dissemination of the results to the agencies, to Congress, and to the public.

Third, OSTP FCCSET crosscuts are extremely time-consuming. This I have learned. They are worthwhile for projects that have clear national importance and cross-agency relevance, but these are not to be used for less urgent objectives.

Mr. Chairman, you asked for my recommendations concerning possible improvements to the bill. We agree with section 102, part B of the bill. It states that high performance networking efforts should "be designed, developed and operated in a manner which forces and maintains competitive and private sector investment in high performance networking within the telecommunications industry." In accord with Dr. Gibbons' remarks, we are concerned, however, about the restriction in section 102, Part d, that a testbed network "shall not be used to provide services that otherwise would be provided satisfactorily using private operating commercial networks."

While this is a very desirable outcome, 18 months after the date of enactment of the bill may be too short a time. We would like to work with the Committee to refine this section of the bill in order to ensure a smooth transition to commercial networks.

Also, NCO welcomes the Committee's plans to expand membership of the legitimate—of the legislatively mandated advisory group on HPCC to include representatives from the K through 12 education and from consumer and public interest groups.

I wish to thank the Committee for this opportunity to comment on the bill, and I would be happy to respond to questions, if you have them.

[The prepared statement of Dr. Lindberg follows:]

Testimony on the High Performance Computing and
High Speed Networking Applications Act of 1993
Before the Science Subcommittee of the
House Committee On Science, Space, and Technology
by
Donald A. B. Lindberg, M.D.
Director, National Coordination Office for
High Performance Computing and Communications,
and
Director, National Library of Medicine

May 11, 1993

Mr. Chairman and Members of the Subcommittee:

Thank you for inviting me to speak before the Subcommittee about H.R. 1757, the High Performance Computing and High Speed Networking Applications Act of 1993. I speak as the recently appointed director of the National Coordination Office that oversees the multi-agency Federal High Performance Computing and Communications Program. In that role, I am a Special Assistant to the Director of the Office of Science and Technology Policy (OSTP). I also serve as the Director of the National Library of Medicine.

A FCCSET Initiative, the HPCC Program is developing the computing, communications, and software technology the U.S. will need to meet its information and telecommunications needs for the 21st century. As the President's Science Advisor Dr. John Gibbons testified before the Committee April 27, 1993, HPCC is a key part of the foundation upon which the advanced national information infrastructure (NII) will be built. This information infrastructure will include high speed communication links, high performance computers, and powerful, but user-friendly software that will give every American access to an unprecedented amount of information, as well as the tools needed to effectively process and use it. It will spur gains in U.S. productivity and industrial competitiveness, improve our national security, and improve the health and education of our citizens.

HPCC has developed computer and communications technologies that have great relevance to applications such as health care, education, manufacturing, digital libraries, and the storage and dissemination of government information. To this end, the HPCC Program has recently added a new component -- Information Infrastructure Technology and Applications to its organizational structure. IITA will support the NII by developing infrastructure technology and applications to demonstrate prototype solutions to National Challenge problems. National Challenges are applications that require access to modern advanced computing and network communications and that have direct and large scale societal impact on the Nation's economy and health.

The National Challenges can benefit from the use of HPCC and information technologies in "customized applications" such as health care, education, design and manufacturing, digital libraries, the environment, energy management, civil infrastructure, and national security.

In order to understand the management of the HPCC Program, I should probably summarize the history of the initiative. The House Committee on Science and Technology sponsored 1986 legislation that resulted in P.L. 99-383, which mandated a report by OSTP that helped lay the foundation of the High Performance Computing and Communications Program. The High Performance Computing Act of 1991 was introduced by then Senator Gore and championed in the House by Representatives Brown, Boucher, Valentine, and others.

The Act (Public Law 102-194) established a National High Performance Computing Program to set goals and priorities, coordinate the programs of Federal agencies, establish a high-capacity and high-speed National Research and Education Network (NREN), and support research, development, and training in all facets of high performance computing and networking.

The following federal agencies are now formal participants in the HPCC project: Department of Defense/Advanced Research Projects Agency; National Science Foundation; Department of Energy; National Aeronautics and Space Administration; National Security Agency; National Institutes of Health; National Oceanic and Atmospheric Administration; Environmental Protection Agency; Department of Education; and National Institute of Standards and Technology.

Through coordinated planning, research, and development, the ten agencies in the HPCC Program are creating a single integrated nationwide effort in high performance computing and communications and for information technology. This coordination enables them to address agency missions such as the computational Grand Challenges, to carry out the systems integration and applications development for the NII, and to leverage efforts in areas of common need and mission overlap. No individual agency has either the mission or the expertise to develop all components, but each agency plays a necessary and unique role.

HPCC commenced funding with the FY 92 Federal budgets. The program was managed at the level of individual agencies and cross- cutting working groups, before the National

Coordination Office was established in September 1992. All participating agencies decided they wanted some central management services and endorsed creation of a coordination office. The NCO coordinates HPCC programs across Federal agencies; acts as a liaison to industry, universities, and Congress; and provides information and communications about HPCC.

Overall program leadership is provided under law by the Office of Science and Technology Policy, through the FCCSET Committee on Physical, Mathematical, and Engineering Sciences (PMES). As director of the National Coordination Office for HPCC, I serve as chairman of the PMES High Performance Computing, Communications and Information Technology (HPCCIT) Subcommittee. HPCCIT meets monthly to coordinate agency HPCC programs through information exchanges, the common development of interagency programs, and the review of individual agency plans and budgets. Meetings of the 13-member group are attended regularly by several dozen additional representatives from government agencies and the Administration who are interested or involved in high performance computing and communications.

An executive committee comprised of a subset of HPCCIT members meets at least once a month, and more often as needed in order to provide a timely response to issues that may arise between regularly scheduled meetings of the HPCCIT Subcommittee.

Within the past year, the HPCC Program and its participating agencies have pursued the scientific Grand Challenge tasks and also certain other scientific applications selected because of their appropriateness to the advanced gigabit test bed site projects. The legislation you have proposed would further expand the program into other important application areas. We welcome the Bill's expanded focus on applications, and the National Information Infrastructure. We believe these represent important and appropriate components of HPCC.

HPCC structure and organization includes a process for strategic planning. The program prepares an annual implementation plan and a budget document that detail objectives, strategies, and milestones for high performance computing and communications efforts, for use of the Committee on Physical, Mathematical, and Engineering Sciences of the Federal Coordination Council for Science, Engineering, and Technology (FCCSET), and the Office of Management and Budget. This process is incorporated into the agencies' planning of their individual and coordinated activities for the next year. In addition, legislative and departmental obligations have required we create and/or respond to numerous other studies and reports over the course of the past year. Two examples are: PMES' need for the report on Technology Transfer Activities within the Federal High Performance Computing and Communications Program and Congress' requirement for the report on the National Research and Education Network Program.

Four HPCCIT working groups meet regularly to coordinate the HPCC initiative. The Computer Research and Development Group, led by the Advanced Research Projects Agency (ARPA), is concerned with basic research progress, technology trends, and alternative approaches to address technological limits in information technology. The Education for High Performance Computing group, led by NIH, coordinates HPCC education and training activities and provides liaison with other education-related efforts under FCCSET.

The Science and Engineering Computing Group, led by NASA, coordinates activities related to Grand Challenge applications, software tools needed for applications development, and software development at high performance computing centers. This applications group has sponsored workshops on systems software development for high performance computing; holds annual Grand Challenges workshops to coordinate these Federally funded scientific teams and hosts bi-annual meetings in which industry representatives describe their future offerings and views concerning key issues that should be addressed by the Government.

Just last week, this group sponsored a four-day Grand Challenges workshop, including a one-day "meet the public" session during which scientists discussed grand challenge applications efforts in areas such as environmental and earth sciences, and computation physics, as well as working group reports on a variety of areas, including the National HPCC Infrastructure. Other panels on industrial applications were held in areas such as aeronautics, automotive, and manufacturing.

The Networking Infrastructure and Digital Communications Group, led by the National Science Foundation, coordinates network integration activities and works closely with the Federal Networking Council (FNC). The FNC consists of representatives from many Federal agencies that are involved with the NREN program. It coordinates the efforts of government HPCC participants and other NREN constituents; and provides liaison to others interested in the Federal program. A Federal Networking Advisory Committee (FNAC) includes representatives of universities, industry and network users.

The HPCCIT Executive Committee is examining mechanisms for perfecting the number and size of these groups. The structure for the management of the fifth component and its relationship with the four existing HPCC components is being planned. Additional task groups are being established to plan interagency coordination and implementation of new applications to use high performance computing and communications technology in medical facilities, libraries, schools, other educational institutions, and ultimately homes and businesses.

There are a host of accomplishments from scientists using HPCC Program facilities and collaboration. We have already reported to this committee in previous testimony, for example, on advances in molecular biology such as sequencing the RNA of the human immunodeficiency virus that causes AIDS, and astounding advances in weather prediction made possible by collaborative efforts in high performance computing and networking.

Mr. Chairman, you asked me to report on HPCC achievements I am personally proud of.

In my opinion, one of the major achievements of HPCC so far is the size, complexity and reliability of the NREN/Internet high performance communication system. Two years ago the number of users of the present data network, Internet, was estimated at about 100,000. Today there are more than one and a half million computers on the Internet and almost 10,000 networks

-- by some estimates, as many as 15 million people capable in many instances of sending and receiving data streams of 45 megabits per second. About 1,000 universities and colleges are attached to and using Internet, and about the same number of high schools. Today, there is also an emphasis on connecting community colleges and hospitals, and on further experiments to determine the best way to attach local school systems.

Monthly traffic in billions of packets continues to climb, with figures more than doubling every year -- from an estimated 2 billion per month in 1989 to 5 billion in 1990, to 10 billion in 1991 and more than 20 billion in 1992. Internet has developed far more rapidly than ever predicted, and has proven to be a stable, secure means of communication.

When fully implemented, users will be able to transmit information at the rate of a billion bits a second (the "gigabit" network).

The NREN currently in place has already revolutionized the ability of scientists to carry out collaborative research with colleagues across the country and world. The developing NII will in time extend this ability to virtually all Americans in all walks of life. As your proposed legislation appropriately spells out, NREN is a program that supports R&D in networking software and hardware to achieve gigabit data transmission rates; sponsors testbed networks to develop and demonstrate advanced networking technologies; and provides support for researchers, educators and students to obtain access to and use of the Internet.

The second major accomplishment of the HPCC Program is its contribution to many efforts that have produced workable, scalable, parallel computers with varying alternative architectures that are actually competing with traditional computers in the marketplace on the basis of price and performance. Three additional American manufacturers joined this activity in the past two years.

A third major accomplishment is that there is one high performance network project within the Federal government. This may seem like an obvious development; it is not. I believe, that without the HPCC project and the OSTP/FCCSET governing mechanism that one would very likely have four and perhaps as many as six or seven large scale high performance computer networks being built by individual Federal government departments.

There are at least as many such major departments with easily justified mission related requirements for high performance networking. That they have contained their enthusiasm for this technology and have, so to speak, sublimated their design principles consistent with their security and mission requirements to accommodate common goals is a tribute both to the high quality of the employees and a tribute to the coordinating mechanisms that were provided by the OSTP/FCCSET crosscut structure.

The incorporation of virtual reality technologies into the HPCC Program is a fourth major accomplishment. This work has come along considerably faster than many thought possible. I am proud that the HPCCIT group welcomed this technology as part of the Information

Infrastructure Technology and Application focus.

Mr. Chairman, you also asked me to note the lessons learned.

Through the NCO experience, I have learned that there are excellent, reliable, and self-motivated people from all ten Federal government agencies and units. These people have a surprising tolerance for the efforts required to adjust common goals to satisfy the numerous agency mission requirements. I very much admire their efforts and contributions. Second, I have also learned that there is a real need for conscious application of ordinary management systems and principles to the operation of this complex HPCC project. That is, brilliant design is not sufficient. The work of the government also requires careful documentation, consensus building, and formal dissemination of the results to the agencies, to the Congress, and to the public.

Third, OSTP/FCCSET crosscuts are extremely time consuming. They are worthwhile for projects of clear national importance and cross-agency relevance, but these are not to be used for less urgent objectives.

The President's Technology Initiative has resulted in increased awareness of and interest in HPCC by a broad range of media, academia, industry and the public. Much of this very high interest is due to the Initiative's increased focus on applications. Since the unveiling of President Clinton and Vice President Gores' technology plan in February, it's hard to pick up a newspaper or magazine these days without reading about information highways. Where does HPCC fit in?

The Administration's proposed 1994 budget would provide $51 million to the National Telecommunications and Information Administration for NII, including information highways. National Telecommunications and Information Administration (NTIA) will focus on the deployment of mature, existing technology to new user communities, such as demonstration projects to improve electronic access for schools and communities. In contrast, the HPCC Program focuses on developing and testing new infrastructure technologies. HPCC is, of course, cooperating with NTIA. The HPCC Executive Committee met with 12 NTIA leaders on April 8, 1993 at the invitation of Dr. Gibbons. NTIA officials have subsequently attended the most recent meetings of the HPCCIT, and have met with representatives from participating agencies. We at HPCC firmly believe that coordination between the two is essential to reap the maximum benefit from these funds and to ensure that the greatest number of persons can profit from modern technology.

Mr. Chairman, you asked for my recommendations concerning possible improvements to the Bill.

In addition to the suggestions noted by Dr. Gibbons in his testimony to you on April 27, 1993, I should like to call attention to two possible improvements.

We agree with section 102, part b, of the bill that states that high performance networking efforts should "be designed, developed, and operated in a manner which fosters and maintains competition and private sector investment in high-speed data networking within the telecommunications industry." We are concerned, however, to the restriction in section 102, part d that test bed networks "shall not be used to provide services that could otherwise be provided satisfactorily using privately operated commercial networks." While this is a desirable outcome, 18 months after the date of enactment of the bill, may be too short a time. We would like to work with the Committee to refine this section of the bill in order to ensure a smooth transition to commercial networks.

The NCO welcomes the Committee's proposal to expand membership of the legislatively mandated advisory group on HPCC to include representatives from the K-12 education and from consumer and public interest groups (which are already represented on the FNAC).

While the HPCC Program has had considerable input and contact with industry, academia, and the public sector, such input on a formal basis is critical for an undertaking as important as enhancing the nation's information infrastructure, and to ensure public accountability and awareness.

I would like to thank the Committee for this opportunity to comment on the High Performance Computing and High Speed Networking Applications Act of 1993. I shall be happy to answer any questions.

Biographical Sketch

Donald Allan Bror Lindberg, M.D.

Donald A. B. Lindberg, M.D., was named the first Director of the National Coordination Office for High Performance Computing and Communications in August 1992. He has served as Director of the National Library of Medicine since 1984. In addition to an illustrious medical career in pathology, Dr. Lindberg has made notable contributions to information and computer activities in medical diagnosis, artificial intelligence, and educational programs. Before his appointment as Director, Dr. Lindberg was Professor and Chairman, Director of Information Science; University of Missouri School of Library and Information Science; Professor of Pathology, University of Missouri School of Medicine, 1969-1984; and Director, Information Science Group, University of Missouri School of Medicine, 1971-1984.

Dr. Lindberg was elected the first President of the American Medical Informatics Association (AMIA), 1988-1991 and in 1992 began serving as a member of the AMIA Board of Directors. He has also been called upon to serve on many boards including the Computer Science and Engineering Board of the National Academy of Sciences, the Symposium on Computer Applications in Medical Care (SCAMC), the American Association for Medical Systems and Informatics (AAMSI), the Organizing Committee for MEDINFO 86, the National Board of Medical Examiners, the Institute of Medicine Advisory Council of the National Academy of Sciences and the Advisory Council of the International Hospice Institute.

Dr. Lindberg is the author of three books: The Computer and Medical Care; Computers in Life Science Research; and The Growth of Medical Information Systems in the United States, several book chapters, and more than 150 articles and reports. He has served as editor and editorial board member of nine publications, including the Journal of the American Medical Association.

Dr. Lindberg graduated ***Magna cum Laude*** from Amherst College and received his M.D. degree from the College of Physicians and Surgeons, Columbia University. Among the honors he has accrued are Phi Beta Kappa; Simpson Fellow of Amherst College; Markle Scholar in Academic Medicine; Surgeon General's Medallion; recipient of the First AMA Nathan Davis Award for outstanding Member of the Executive Branch in Career Public Service, the Walter C. Alvarez Memorial Award, American Medical Writers Association; the Presidential Senior Executive Rank Award; Founding Fellow, American Institute of Medical and Biological Engineering; the Outstanding Service Medal, Uniformed Services University of the Health Sciences; and honorary doctorates from Amherst College, the State University of New York at Syracuse and the University of Missouri-Columbia.

Mr. BOUCHER. Thank you very much, Dr. Lindberg.

Dr. Kalos.

Dr. KALOS. Mr. Chairman, members of the Subcommittee, it is a privilege to be here.

I have the honor, also, to be the successor of Dr. Ken Wilson, whose testimony of about 10 years ago was cited by Mr. Gage earlier.

The Cornell Center is a national center, one of the four National Science Foundation Centers, but it is also supported by New York State, by ARPA, NIH and industry. That means that the Federal support is highly leveraged, less than half of our support comes from the NSF. It also means that our mission is very broad and recognized as such. We are also members of the other consortia: of the NSF Metacenter, of the National Consortium for High Performance Computing, and the Coalition of Academic Supercomputing Centers.

We join in applauding the leadership of Congressman Boucher and cosponsors of this bill, which addresses one of the most important opportunities facing our Nation: How to exploit the most striking technological revolution in history to benefit the country as a whole? We would like to express our appreciation to Congressman Boehlert, Brown and Valentine for their strong lasting support of the entire HPCC program.

As you know, the failure of the recently proposed stimulus package meant the loss of additional support for the Computer and Information Science and Engineering Directorate and the networking activities at NSF. I believe this was a serious setback for the aims of this bill, and I believe that the support for these activities should be restored to levels adequate for the aims of the bill.

As you well know, computations and communications have advanced more in the last few years than in all prior history. This owes very much to the National Supercomputer Centers. In particular, the Metacenter, which pools their resources, is a national computational environment with unprecedented capability for Grand Challenge and National Challenge programs. With the NCHPC they create a rational plan for improving computing, communications and educational resources. It is a framework for partnership with State and regional centers, and with the DOD through ARPA, in defense conversion and modernization efforts.

The NSF Centers have an unparalleled record in joining the results of individual investigative research to industry and other national needs, and that is a key to the aims of this bill. The Centers have been critical, as other witnesses have mentioned, to industry's use of high performance computing. They have stimulated the pace of computer development including the revolution that exploits scalably parallel computers.

The concept of scalability is absolutely crucial in this. That means solving problems with exactly the necessary resources; for example, first on a personal computer, and then for larger problems, but no change in software, on a large machine that is needed for a very large application.

Our recommendations for H.R. 1757 are, first, about networking. The legislation should encourage the interrelationships among gigabit testbeds, among precommercial activities that diffuse new technologies into the marketplace, and production networks. Clearly, commercial carriers should provide production networks. But the government must continue its assistance of the rest. Educational and research institutions offer value-added services comprising virtual networks and knowledge about their use. Above all, there should be no rigid time scale for a move to private operation.

I think the impact on education is, perhaps, the most long-lasting result that can come out of this legislation. Our Centers have provided national leadership in this respect. Cornell's Super Quest program, which is now countrywide, involves high school students in research activities. Pittsburgh and San Diego have successful summer programs to educate teachers. From these foundations we will start an educational cascade to reach all of America.

The bill's program should include projects whose target is coursework in areas such as mathematics and English involving teachers, disciplinary and multimedia specialists, and computer scientists. The National Centers, NCHPC and CASC are admirably equipped to integrate such projects. These have emerged as the premier technology integrators, which is exactly what is needed here.

The second greatest impact will be on health care. In particular, I second the remarks of Dr. Herron. The role of high performance computing in such areas as drug design, analysis of medical images, and the design of improved prostheses should be reaffirmed. I believe the governance of the HPCC has been effective. The creation of an Associate Director at OSTP for scientific and technical information is important, and the leadership in HPCC exerted by the next NSF director will be essential.

I thank the Committee for this opportunity to comment on the bill. I reiterate the importance of acting within the framework of the existing infrastructure that has so effectively emerged. The costs do indeed loom large. I believe the opportunities are very great, especially when you think about education and health care. The sums now spent nationwide on education and health care are enormous, and the opportunity to make those sums much more effective for the aims we all support is before us.

Thank you, Mr. Chairman. Thank you, members.

[The prepared statement of Dr. Kalos follows:]

Testimony of Malvin H. Kalos
on theHigh Performance Computing
and High Speed Networking Applications Act of 1993
H.R. 1757
before the House Subcommittee on Science

May 11, 1993

Mr. Chairman, and members of the Subcommittee on Science, it is a privilege to be invited to comment on the "High Performance Computing and High Speed Networking Applications Act of 1993" in the company of such distinguished representatives of government, industry, and academia.

I am Malvin H. Kalos, Director of the Cornell Theory Center, and a professor of physics at Cornell University. The Theory Center is an interdisciplinary research unit of Cornell, dedicated to the advancement and application of high performance computing and networking for the support of science, engineering, technology, education and economic well-being. As you know, the Theory Center is one of the national Supercomputer Centers supported by the National Science Foundation. The Center also receives support from the State of New York, from ARPA, from the National Institutes of Health, and from industry. We are a member of the NSF Metacenter, of the National Consortium for High Performance Computing (the NCHPC is an organization of NSF, academic, and DoD centers) and of CASC, the Coalition of Academic Supercomputing Centers; as such we are a significant component of the National Information Infrastructure in its present form.

We applaud the leadership of Congressman Boucher as the author of H.R. 1757, which addresses one of the most important opportunities facing our Nation: How we can best exploit the most striking technological revolution in the history of civilization for the economic and social benefit of our country and of its people. The authors and cosponsors of this Bill deserve our gratitude for their foresight. We would like also to express appreciation to Congressmen Boehlert, Brown, and Valentine, members of the committee whose support for the entire HPCC program has been very strong and effective.

Since I have been asked to address strengths and weaknesses of the HPC program, I must voice my strong concern about the base funding of the National Science Foundation, which provides and supports the infrastructure that has enabled the adoption of high performance computing and communications as part of our technological society. The failure of the recently proposed stimulus package that would have provided the Computer and Information Science and Engineering Directorate at NSF with $47.7 M, including $9.0 M for the supercomputer centers was a serious setback in this regard. Networking activities of NSF were also adversely affected when these crucial monies were not forthcoming. A way must be found to restore this vital support to the level where the infrastructure is adequate to enable the aims of H.R 1757.

Mr. Chairman, the field of computation and communications has advanced more in the last few years than in our entire previous history. Much of this development has been sparked by the Supercomputer Centers founded at the behest of Congress and administered by NSF. The Centers, located at San Diego, California; Urbana-Champaign, Illinois; Pittsburgh, Pennsylvania; and Ithaca, New York; now come together as a national Metacenter, which signals a new era of cooperation and collaboration that will make an even more effective contribution to vital National needs.

The Metacenter pools the computational resources of the Centers, creating a national computational environment that will bring unprecedented capabilities to bear on Grand Challenge and National Challenge problems in science, engineering, and industry. The Metacenter and NCHPC create a rational and cost-effective plan for upgrading the high performance computing, communications, and educational resources of the Centers. This conjunction also provides a collaborative framework that includes partnership with other agencies and other entities (such as state and regional centers) and with the DoD through ARPA in effecting the vital defense conversion and modernization efforts.

This Bill foresees the flowering of developments of the last decade - developments that have had a vast and positive effect on the scientific community and that now can be turned to the general good of the National community.

The NSF Centers' long and effective record in bridging the gulf between the individual-investigator initiated research supported by NSF and its application to industry and other national needs will be a key element in the programs foreseen in this Bill. The centers have played a critical role in introducing and supporting industry's use of high performance computing to improve our nation's competitiveness. Equally important, the centers have stimulated the computer manufacturing industry to speed the pace of development. Now the centers are in the forefront of the revolution that exploits scalably parallel computers.

I am often asked why, given that the computer age is about 50 years old, it is reasonable to expect striking advances in revolutionizing education or health care now. The answer lies in the idea of thresholds: technology advances until it passes some critical level. Suddenly things can be done easily that made no sense before. For example, the omnipresence of personal and portable computers has had enormous unanticipated benefits for our society. The knitting together of the world's scientific community by electronic networking has changed the way science is done, providing both collaborations on a global scale and a new information infrastructure that accelerates the way in which scientists build on each other's work.

We are at the convergence of thresholds in video technologies, personal software, exponentially growing supercomputer technologies, and high-performance communications, that if properly integrated will make a huge qualitative and positive change in our lives. Striking examples can be found in our research at the Theory Center. One is an emerging collaboration between our Center and the work at the Cornell Synchrotron source used to measure the properties of biological molecules, such as HIV reverse transcriptase-- the target for AZT, DDI and DDC, the only approved drugs for the treatment of AIDS. The outcome of this collaboration will be a vast increase in the cost-effectiveness and the timeliness of the experimental research through the use of powerful state-of-the art computers networked to the detectors, giving real-time analysis of the observations.

Right now, we are crossing critical technological thresholds in scalable networking and scalably parallel computing. The concept of "scalability" is crucial: it means the ability to solve a problem at whatever scale of resources is necessary, first on a personal computer, then, for some much larger case, but with no change of software, on a remote very large machine at a center. These technologies are advancing at the most rapid rate in the history of computing and create an urgent requirement to build up the national computational infrastructure.

Experience on the Internet has been analogous to building new highways: Build them and people will come, creating new industries and jobs not dreamed of before. There are now more than a million connections to the Internet. The load doubles every six to seven months. It will be essential, for the purposes of this Bill to anticipate the future needs for communications bandwidth, both for mail-like traffic, and for very high-bandwidth interaction among supercomputers and between supercomputers and experimental devices.

The success of the NCHPC in exploiting the high speed networks for the benefit of the nation's industrial and academic scientists and engineers will create the need for even greater capability very soon-- as high school students collaborate with students a thousand miles away using video conferencing; as teachers use Internet information navigators; or as researchers share computer generated animations of their latest results in electronic team meetings on a national scale.

I reiterate my support for H.R. 1757, which will provide support in critical areas. My specific recommendations for improving the Bill are the following.

1. Network Access and research in support of applications. We must recognize the interrelationships among the experimental, pre-commercial, and product facets of a national information infrastructure. Experimental work, conducted by government-supported network activities in, for example, the Gigabit testbeds, advance networking technology. Pre-commercial activities, again government assisted, are designed to diffuse the new technologies into the

marketplace. These should continue to be government assisted, whereas production network technology operations-- the operation of present and future commercially available networks-- should be based on the services of commercial carriers. Educational and research institutions can offer value-added services in organizing virtual networks and providing knowledge about their use. It is reasonable that the Federal and State governments assist in the latter roles.

The present arrangement has worked well: federal investment has been leveraged many times over by investments by state, private, and local universities, and by the carriers.

I urge the Committee to reflect also that universal networking and access are only a beginning of a major process in which the integration of many other technologies can serve to make the changes we seek. I have mentioned some of those above. It should be added that new training, an informed public, and perhaps above all a cultural change to cooperation and communication will be imperative. Of course the outcome of the Bill will in fact serve these ends in itself.

2. Applications in education and applications for libraries. This Bill will enhance activities that make our high schools-- indeed all of K through 12-- more competitive. The Centers have provided national leadership here: Cornell's SuperQuest, now a country-wide program, is an outreach to high school students and teachers that provides the next generation of scientists the opportunity to participate in challenging research activities using the facilities of the Centers. Pittsburgh has a very successful summer program to educate teachers. We are planning now to build upon these foundations to start an educational cascade that will reach all of America.

The program envisaged by this Bill should start with major national pilot projects that are truly interdisciplinary and whose aim is to develop multi-media based courseware in several areas such as mathematics, history, English, and general science. These pilot projects would involve teachers, academic and multimedia specialists, and computer scientists. The National Centers, through the NCHPC, are admirably equipped to coordinate and integrate such projects, and to adapt these educational tools for retraining the workforce and for informal education. This will provide a basis for the technical retraining so urgently needed by our workforce, training that can be carried out in many ways that can match the diverse need of individuals.

The libraries across the country are the logical sites for informal education. They can serve as self-learning centers that provide free access to educational tools and communications for the broadest possible public. This will include communications with government at all levels by access to public records, dialog with public officials and the like. Such public facilities can serve to erase gaps in the access now available to different parts of our community, and to enhance our democratic process.

3. Applications for Health Care. High performance computing and communications hold tremendous promise for improving health care delivery. Again I urge the addition of support for pilot projects that provide computer-assisted interpretation of medical tests, especially radiology, remote consultation, and multimedia integration of patient records, including radiology and other test records.

I also urge the committee to recognize and continue the support of the growing and essential applications of advanced methods, especially high-performance computing and communications to biomedical science and through that to the improvement of health care. The example given above on the linking of experimental observation to powerful computation is only a single one in a growing body of understanding of the fundamental mechanisms of physiology. Biomedical research is a strong activity at all of the NSF Centers; Cornell and Pittsburgh have major grants from NIH for such work. Cornell's Resource is aimed specifically at bringing scalably parallel computing into the biomedical field.

May I suggest that there be specific language that affirms the role of high performance computing in such areas as drug design, analysis of medical images, and the design of improved prostheses, as examples of how high performance computing can advance the delivery of health care.

I have been asked to comment on the record of the governance of the High-Performance Computing effort so far. I believe that it has been effective. The creation of an additional Associate Director at OSTP to oversee Federal efforts to disseminate scientific and technical information would be a significant step towards the accomplishments foreseen by this Bill. Since the role of the National Science Foundation in the existing and future High Performance community is so fundamental, the leadership exerted by the next Director will be of the utmost importance.

The broad response that this Bill seeks will enhance the aims of reaching throughout the National community, but I would caution that the needs are urgent. The proposals I have made are broad and generic. The speed with which we can make a start is an essential ingredient of success.

In closing, I want to thank the committee again for this opportunity to comment on the Bill, and to emphasize the importance of acting within the framework of the existing infrastructure that has so effectively emerged. We should all reflect that the costs that quite properly loom large here are an investment in education and in health care that will undoubtedly be repaid many times over in greater competitiveness and in an improved quality of our lives.

Mr. **BOUCHER**. Thank you very much, Dr. Kalos. I particularly want to commend you on being the first witness who has testified before this Committee using a personal computer for that purpose. I suspect the day is not very far away when witnesses and members alike will come armed with those in order to engage in questions and answers.

Dr. **KALOS**. Thank you, Mr. Chairman.

Mr. **BOUCHER**. Ms. Eshoo asks whose equipment is it? If you don't mind telling us that.

Dr. **KALOS**. I'm sorry.

Ms. **ESHOO**. Whose equipment is it?

Dr. **KALOS**. This is a Macintosh Powerbook.

Mr. **BOUCHER**. I'd like to express the thanks of the Subcommittee to each of these witnesses for the very helpful written testimony, which is a part of our record and will be carefully reviewed as we move toward markup of the legislation, and for the very interesting oral comments that have been made this morning.

I'm going to take just a few minutes at the outset to inquire of you about the implementation to date of the High Performance Computing Act of 1991, and then in a subsequent round of questions I will talk with you about the new legislation that we are proposing.

One of the objections, I guess you could call it that, that has been raised before this Committee is that some of the agencies that have been participating in the High Performance Computing Act of 1991 have really not been looking out to try to identify and pursue new research projects, but with the funding they have received, have essentially just been relabeling ongoing operations and projects that they had. And that not very much that's new, for that reason, is actually being produced as a consequence of the High Performance Computing Program.

I'd like your comments on the extent to which that may be accurate. And a corollary to that question is can you identify for us the kinds of research advances that would not have taken place had it not been for the projects that were authorized and funded through the High Performance Computing Act of 1991?

So, to summarize that question, have the agencies just been relabeling existing projects or are they really engaging in new research? And what kinds of advances have occurred that would not have occurred as a consequence of the passage of the 1991 Act?

Dr. Weingarten, let me start that with you because you raised this concern to some extent in your testimony.

Dr. **WEINGARTEN**. Thank you, Mr. Chairman. The question as phrased is a little difficult for us to answer, at least from the basic research side. That, of course, has been CRA's particular focus all along in the High Performance Computing and Communications Act, in part because, as I suggested, the appropriations in many cases have not followed the authorization, and NSF in particular has had the problem of trying to somehow adopt new responsibilities within existing budgets or even shrinking budgets.

And so teasing apart, within the NSF programs what grants were made because of the program that would not have been made without the program. It is a little hypothetical.

On the other hand, I would say that the advances in networking that Dr. Lindberg talked about and the commitment to NSF to growth of the Internet, the development, the continued development of the Supercomputer Centers, the move of computer science toward a broader focus on applications, particularly in computational science but also more broadly, would not have occurred as fast without the High Performance Computing and Communications Act.

I know the entire cultural view of the computing research community has changed over the last few years, or has been changing. It's evidenced by the National Academy of Sciences report, "Computing in the Future," in which they talked about the need to broaden the focus and purposes of computing research. And to us the High Performance Computing and Communications Act was a major test point in making that cultural change within the research community.

I think the emphasis within the community on parallel computing and developing programming languages, doing increasing research on the massively parallel architectures and so on has occurred because of the emphasis of that Act. It is a little harder, as I said, to point at specific projects or specific research findings that would not have been made had the Act not been passed.

Mr. BOUCHER. Mr. Kalb.

Mr. KALB. Yes, Mr. Chairman. There's two points I'd like to make. First of all, within the program itself, as I understand it, many of the funds which are considered part of the HPCC effort today in fact were funds that were being invested in this area prior to the formal presentation of the legislation, and that's important because of the second point that I'd like to make, which is that in general it takes more than, you know, 12–18 months to see progress in these kind of programs. It takes, you know, 6, 8, and maybe as many as 12 months to get the programs initiated, and most research and development programs go for 1 to 2 years. So I don't think we've really seen the results of any—of the incremental funding that's been put in there, and what we are, in fact, witnessing is the results to date of research that was done on those. But I don't think that's a negative comment in any sense of the term because that's, in fact, just the way research is. We wouldn't expect to see demonstrable results from the funds that have just been invested in the last year, but I think we will.

Mr. BOUCHER. So, in that sense you would characterize the 1991 legislation as providing an accelerating effect for research projects that were already underway?

Mr. KALB. Yes. And we will only start to see the results of new projects within the next couple years.

Mr. BOUCHER. OK. Dr. Kalos.

Dr. KALOS. Mr. Chairman, I'd like to give a couple of examples based on the work at Cornell and in part based on my own research. My background is computational physics and the application to materials. The move to the support of parallel computing and computational investigation of materials have had a positive impact. We've been able to hire very good post-docs and direct them to work in that area, and I believe that the scientific output will be very important. And I believe that their use of parallel computing as a routine research tool will emerge from this.

Even more important, I have seen a real change in the attitude about—at the National Institutes of Health. They have seen the light. They are seriously interested, and my paragraph in the written testimony and my oral remarks attest to that. They have become extremely interested in the impact of parallel computing. They have funded a number of Centers, including an activity at our Center.

And I would cite something that hasn't happened yet, but as a process at Cornell there is a synchrotron laboratory which is used very extensively to measure the properties of biological molecules, including potential drugs for AIDS. Computational molecular science and observational molecular science are natural partners. One of the things I learned at the National Institutes of Health is that the synchrotron facilities could be very much more effectively used were high performance computing and networking brought to the reduction of the observations. And we have formed a partnership with the molecular part of the CHESS facility at Cornell to do exactly that. That was inspired by our connection with NIH, and I think that will emerge as a very powerful cost saving tool in this kind of research.

Mr. BOUCHER. Thank you very much.

Well, it sounds as though research advances are, in fact, being made as a consequence of this program, and that—your general conclusion is that we have not simply seen a relabeling of existing research, but to the extent that there has been a continuation of previously existing research, the new program has had an accelerating and therefore positive effect.

One of the other complaints that has been received is that there has not been an adequate opportunity for non-governmental input and advice being offered to the coordination of this program. I'd like your comments on the extent to which you believe that to be true. And then to move to the new legislation that we have offered, H.R. 1757, your advice with respect to whether the new conduit that we are providing through an external advisory committee that would be provided, that would be composed of nongovernmental participants is a remedy for that problem to the extent that it exists.

Dr. Weingarten.

Dr. WEINGARTEN. Thank you. I think in CRA's view there has been in some cases some difficulty in communicating the public's views on some of the program formulation. I believe that's in part due to the fact that we have a multi-agency program in which different agencies have different traditions and different established histories of soliciting such advice and talking with the outside world.

An advisory committee would, in fact, be very helpful. We've been hoping for the last year that the one called for in the previous Act would in fact be formed, and we applaud the efforts to broaden the focus of that committee and to somehow prod its coming into being. Advisory committees are useful, but they do have their limitations. They only meet every once in a while. They are staffed by agencies to whom they are supposed to provide advice and so on.

One possible point of strengthening the bill that occurs to me is that in the section that describes the role of the Coordinator, it says that the Coordinator should serve as a point of contact for the Congress and the public. One might strengthen that specific formulation in particularly directing the Coordinator's office to solicit outside public input for those kinds of reports and plans that his office is supposed to produce.

Mr. BOUCHER. Duly noted. Other comments?

Mr. Kalb.

Mr. KALB. Yes, Mr. Chairman. One of the failings, I think, of the present program has been the lack of appointing the High Performance Computing Advisory Group that was specified in the original legislation, and I think that if that in fact had been done we would be getting more public input into it.

The other thing I would like to emphasize from our written testimony and also my verbal comments was that if in fact we were to create a road map, a technological road map through these offices that would be a very strong way for industry to make its inputs into the problems that need to be solved, to get at least a list of them on the table in terms of allowing people then to focus on the specific interests of industry and the semiconductor industry's group, the Semiconductor Research Corporation and other organizations have shown that to be an extremely effective tool, not for managing the program, but for giving it direction, giving it cohesiveness, and so on.

And I really would like to again emphasize that that could be a very effective way for industry and others to make their voices heard.

Mr. BOUCHER. I'm going to call on Dr. Lindberg for his comments, and just ask him one additional question to add to the notes he has already taken there. And that is, is your office today used by the private sector? And to the extent that it is, how many inquiries would you estimate that you get per week from private sector entities who are interested in the High Performance Computing Program.

Dr. LINDBERG. Mr. Chairman, I'll answer the last question first. I would say a minimum of six. That would be one a day. And we are happy to do that. That's one of the reasons we're there. In fact, I'm going to have a meeting with a private corporate group immediately following this hearing, at their request, and give advice concerning a statewide Governor's office task force on, we think, an activity relating to high performance computing.

Also, I'd like to endorse the kind of idea that Jeff Kalb put forward for kind of a technological road map and a long-range plan. This should be done. But I do want to point out that I have to have an advisory group. I mean it is simply inappropriate for me to sit down with Jeff or anybody else and manufacturer A and say, "Please tell me how to run this program?," without being subject to the criticism, you haven't had the input from the entire industry. It's totally inappropriate. It's illegal. It should be in compliance with the Federal Advisory Committee Act, and that's exactly what we want.

So, in the meantime what has the office done? Well, we have sponsored a number of meetings amongst which were presentations, although those were confidential, from every single manufacturer of parallel computers in the U.S., including many at the table, for 2 years running. Those have been extremely helpful to us, and we hope to the companies.

Just last week the NASA on behalf of HPCC and our office as well sponsored a meeting in Pittsburgh on grand challenges, and those were attended by the public and by industry and by the universities. The last day was totally public, and I chaired an industrial panel. I must say we learned a tremendous amount.

So we're very enthusiastic about industrial participation both for guidance and as a means of technology transfer. But we plead with you to give us a legal advisory structure.

Mr. **BOUCHER**. I guess I would respond by saying that the old law did contain an advisory committee structure. The President for reasons I am sure that were to him sufficient decided not to appoint that committee and therein lies the current problem.

Should we at this point be encouraging the Clinton administration to appoint that committee forthwith, or would it be more appropriate to enact this measure, which has an expanded advisory committee beyond the confines of the one in the 1991 law? What is your advice? Should the President appoint the old committee and get that up and running until this bill becomes law, or should we simply wait until this measure is enacted, potentially sometime later this year, and have the expanded advisory committee that it contemplates? Any advice?

Mr. **MASI**. Yes. I would recommend getting started now. It is long overdue. All of us have seen the results of not having a focal point for industry.

I just might add, that I think industry has a bit of responsibility as well. We're beginning slowly to try, as an industry, as a high performance computing industry to provide some input and guidance, and there has been input that has come forth from CSPP, but there are many smaller high performance computing companies that are not members of CSPP. So I think we share a bit of the responsibility. However, we need someone to speak to.

Mr. **BOUCHER**. Does anyone disagree with that?

[No response.]

Mr. **BOUCHER**. Unanimous agreement. OK.

I have some questions about the new legislation we have introduced, but before propounding those I'd like to recognize the gentlewoman from California, Ms. Eshoo, for her questions.

Ms. **ESHOO**. Thank you, Mr. Chairman. This is a wonderful hearing. I have learned a great deal from each one of you, and I thank you again for being here today. I just have a couple of questions.

The first is relative to the new legislation. What do you think we can do to ensure that we don't somehow lock the network structure and the computer technologies into today's level of capability?

[Pause.]

Ms. **ESHOO**. Anyone. I see more PCs coming out here. I think John has the answer in that machine.

Mr. **BOUCHER**. Could you please identify yourself for the record?

Dr. **DIFFIE**. Yes, sir. How do you do? I'm Whitfield Diffie. I'm the—as well as we do for an expert in security at Sun Microsystems, and I just want to suggest that that very issue has been on my mind with respect to the recent administration proposal for what's called the Clipper chip, a new cryptographic standard that would—most of which would remain classified. And one of our deepest worries there is that if essential technology, technology essential to tomorrow's networks, is embedded in tamper-resistant chips which, if we are to believe the administration, the NSA will be—functioning will remain secret indefinitely. That means an essential technology will be locked in the hands of those companies to whom the government decides to give the contracts to produce these chips.

And the open process that has produced competitively better and better computing technology over the past generation, particularly in our own Silicon Valley, is likely to be squeezed out by this dependence on standards that are tightly controlled by small parts of the government and industry.

Ms. ESHOO. You've described it eloquently, but how do we avoid that? What you just described so well?

Dr. DIFFIE. I think that the tools for computer security are already abundantly available in private hands today, and the difficulty, the reason our networks are not vastly more secure than they are now and not as secure as they should be is not one—a problem of developing individual components and tools. I think the public community has already done that. I think it is a combination of two things. One is that as you move from individual technique development to broad application to networks you run up a bigger bill than university research groups, for example, small industry research groups can handle. So there is going to be some intrinsic expense in installing the infrastructure security on our networks.

The second place we have a problem, and that money might very well come from industry except for a particular problem, at Sun, and I imagine we're typical in this respect, is that approximately half of our market is offshore, which makes us subject to the export control requirements. As a result, I just cannot sell to my management a major undertaking that can only go into half the systems we deliver. They just say, you know, we have a one system policy. Oh, yes, we can have a few little packages here and there to add on. But if you are telling me that in order to enable new application interfaces, new uses of the network, we have to install some set of components in our machines and in our software that we will not be allowed to export, that just produces more diversity in our product line than we're able to handle. You just have to find some other way of doing it.

And that has had one other curious effect, incidentally. There are things that the U.S. Government would very much like, very much needs. We are capable of delivering these things to them, but the development base required to produce them has to be broader than our specialized government development activity. So the government itself is suffering from the result of this policy in terms of computing services we could provide it but are unable to under the present regime.

Ms. ESHOO. Thank you very much. Yes?

Mr. KALB. Yes, Ms. Eshoo. I think that one of the ways we can control this thing and make sure that we're moving forward in the technology is to make sure that there is a significant enough component from the research community. The legislation that's being passed, obviously, envisions moving the technology down into the K–12 and various other areas. It's been my experience that there there would be a very strong focus on, perhaps, much smaller applications, which may not put as big a demand on the networks and computers as there would be if we maintain a fairly strong driving force from the high end technology pieces.

Actually, I've had concerns of a slightly different nature in that I believe as we start attaching large numbers of people into these data sources, and Library of Congress or various other things where we want to make information accessible, that we in fact might have the exact opposite problem. We have seen situations even now where when an agency goes to do a large data analysis problem, not large in terms of how much it takes to request it, but large in terms of the computational capabilities, that this could run—it can run days and sometimes even months on a single problem.kind

So one of the dangers that we'll face as we connect thousands and thousands of people into these kinds of data sources is that we could create what people call "light dimming" events where you literally take major important computer systems off-line for hours at a time for simple things. And I think those kind of things will, in fact, drive people to get the latest technology because they won't be able to stay up with the requirements without it.

So two pieces: High—keep a strong influence from the technology-driving community, to keep that moving forward; and secondly, trust too the fact that people are probably going to overload this thing real quickly.

Ms. ESHOO. Thank you.

Mr. BOUCHER. Thank you very much, Ms. Eshoo.

Let me turn now to questions concerning H.R. 1757 and get your views on what has proven to be one of the more discussed aspects of the legislation, and that is our desire to ensure that there not be competition between the government and its networking role and the private sector. The National Science Foundation is in its recompetition of the NSF net already moving toward a regime where instead of the government providing direct subsidy to the network itself and providing for the carriage for free of traffic of all kinds, research and education primarily, over the network, that the government will require that anyone who can purchase a commercial connection do so, and that would include the research and education community.

In order to ensure that those connections are affordable, the government's role would shift. It would not be network subsidy as much as it would be the provision of direct subsidy to regional networks or to the research and education users themselves directly.

Now, a lot of concern has been expressed about the transition from one regime to the other and how smooth that's going to be, and whether people in the research and education community might be left at some point without adequate subsidy at a time when their access to the network, the government subsidized network was foreclosed.

I'd like your general comments, and if you want to talk about the NSF recompetition you can feel free to talk about that. More specifically, I'd like your advice with regard to the provision we have in our legislation which would say that that transition should be completed within a period of 18 months, and at that time anyone who can purchase a commercial connection must do so, and we would reserve then the government network for that traffic that requires the higher speed that only the government network can provide.

So your thoughts on the adequacy of that provision and any recommendations that you might have for other ways that we should address this concern.

Dr. Kalos.

Dr. KALOS. As I commented before, I think that a rigid timetable, especially one that has no performance requirements, is probably a mistake. I think that the interplay of experiment, of new technology, and well-founded production networks will continue in the indefinite future, and we need to have a mechanism for integrating these, perhaps through a technology road map as indicated, that covers the evolution of networks, not only in bandwidth, not only in connectivity, but in function as well.

In addition, I hope the outcome will not be that researchers like myself or many other people need to use a variety of networks, a variety of protocols, depending on what we happen to be doing at any particular time. We have learned from previous experience with communications that simplifying the protocols is absolutely essential for unifying the system.

Mr. BOUCHER. Let me ask you a couple of questions about how the regional networks operate today. You have experience with regional network operation, I believe.

Dr. KALOS. No, not directly.

Mr. BOUCHER. You do not?

Dr. KALOS. No.

Mr. BOUCHER. Does anyone on the panel have experience with a regional network operation? The reason I ask the question is I wonder what kinds of services the regional networks provide beyond mere connections. Do they offer, for example, technical assistance to users?

Dr. Lindberg, would you like to comment?

Dr. LINDBERG. Sure. You probably want to hear from an outfit called FARNET, which is a not-for-profit collaboratory of those regional networks. But I think of them because they produced the first technical manual on how to use the whole Internet. They also produce lists—routing tables, so called. They provide a lot of services and that varies from region to region, but outreach and training is pretty high in that list.

Mr. BOUCHER. All right. Dr. Kalos?

Dr. KALOS. In that line, I can add a very important comment. The North Carolina network has been a pioneer in video connection, and we at the National Centers have followed their lead and their technical assistance in setting up our own video interconnection system.

So many of these have particular expertise which they share with us.

Mr. BOUCHER. Is there some concern on the part of the user community that, if we effect this transition to a time when we require that commercial connections that can be purchased be purchased, that the commercial networks might not provide anything beyond mere connectivity and might not provide the kinds of technical assistance that is available today from the regionals? Is that a valid concern?

Dr. KALOS. Yes, that is a valid concern.

Mr. BOUCHER. All right. Mr. Gage, I see you nodding your head.

Mr. GAGE. It's important to understand the overall organization of the Internet since technology changes so rapidly people can't wait, and that's the problem with advisory committees. It takes a while for the committee to meet. So there is a necessary layering, and it goes directly to your question about the functioning of the advisory committee.

What's needed is a committee that says the desirable goal, the what and not the how. And so when you ask can there be or will there be in 18 months adequate provision of networking speeds from commercial vendors, we don't know. Yesterday, in North Carolina, there was an announcement that Bell South is providing broadband ISDN to over 3000 schools. This is wonderful. This is something that was not anticipated, and suddenly we're going to have serious speed reaching schools, libraries, throughout the State of North Carolina.

Now, maybe that will be copied in Nebraska and in California and other places. We can't tell. We need to specify what we want. That's high speed connection, cheap connection, and we want to disrupt the research results, the research teams that exist today as little as possible. That means we don't want to make one scientist spend a minute thinking about taking a special network routing to avoid some noncommercial ban.

This has been a problem. We have not been able to make the life of the researcher focus on research. Instead we have taken graduate students and post-docs and spent their time trying to figure out network routing so that they can comply with a law that bans use of the network in some moderately commercial uses. So we want to—our goal is, I think, without going into it deeply, our view on this would be the first goal is to allow American science to interconnect as easily and cheaply as possible, disrupt them as little as possible.

Mr. BOUCHER. All right. That's certainly our goal as well. There is a competing goal, and I think we have to acknowledge that, and that is, that the private sector is very interested in assuring that the government-supported network does not compete with what the private sector provides. And, you know, traditionally we have had a goal of not having the government in competition with private providers. That went right down, in fact, to the removal of this statue from the top of the Capitol dome this past Sunday. There was a competition between the National Guard and its helicopter and a private provider, and while the National Guard had more precise experience with this kind of thing, having removed the one from the Texas capitol dome, the private provider got to do the job—successfully, fortunately.

But that's a principle that we respect, and so how do we accomplish the achievement of both of these goals simultaneously?

Mr. Gage.

Mr. GAGE. Just one small comment. It's been our view that the primary activists on this front, the telephone companies, have never fully understood that they make a lot of money from the existing arrangement. They don't have a way to see that, so they think that, in fact, they're not making as much as they could. They're wrong. They will benefit from this expansion network more than anyone.

The new players, the cable companies, the utilities with adequate bandwidth, anyone with right-of-way that allows a fiber to reach you will be making money from this expansion of the use of the network as the digital libraries become pervasive and a part of our lives. So we don't worry about them as much as they—they will lobby a lot for them, so we don't worry about that.

Mr. BOUCHER. But let me ask you now, what's wrong, in theory, with saying that the government-supported network will be a very high-speed network with capabilities beyond what the private sector offers, and then say that to the extent that the private sector does offer a network that provides a speed adequate for an individual usage that that usage must be accommodated on the private network, not on the high-speed government network?

So we reserve the government network as a testbed for demonstrating new technologies and providing connections where the private sector does not have the current level of capability in order to do it. What's wrong, in theory, with that?

Mr. GAGE. In theory, nothing. I just don't think we need to reach that. At this moment there's a trench headed to my office that bears a fiber from Sprint, 622 megabits. Had it not been for the gigabit testbed in the same area they wouldn't have been inspired to beat it. So it may just be a provision that——

Mr. BOUCHER. But we intend to maintain the gigabit testbed; in fact, develop that testbed and expand it further, and always keep that beyond where the private sector's level of capability is.

Mr. GAGE. Yes. Match this is the game, you always say.

Mr. BOUCHER. Exactly.

Mr. GAGE. And we would do this.

Mr. BOUCHER. That's exactly what we intend.

Mr. Kalb.

Mr. KALB. Yes, Mr. Chairman. I think the idea behind that is an excellent one. We ought to be using the private sector to do stuff whenever possible.

I think the place that it may become difficult is when you have the fixed time line, and it may be that the best way to deal with that is with criteria as opposed to a date. That would be the only suggestion that I would make.

Mr. BOUCHER. Well, I think that is a good suggestion, and Dr. Kalos, in fact, was suggesting performance standards and let's talk about that. What kind of performance standards would make sense as a way to get away from a fixed date?

Dr. KALOS. Well, of course, obviously, bandwidth, connectivity—I would say cost.

I would like to comment, though, on what you just said—comment and point out that experimental use of networks is not synonymous with high bandwidth. There are many important experiments that can be carried out now, and need to be carried out in the course of the implementation of the aims of H.R. 1757. And I think that the distinction between experimental, precompetitive and production networks needs to be maintained forever.

And, as I say, experiment is not synonymous with high bandwidth.

Mr. BOUCHER. It may be synonymous with speed, however. Would you agree?

Dr. KALOS. I don't understand.

Mr. BOUCHER. Well, the speed with which data can be routed, and the size of the packets that can be routed, and the number of packets that can be routed at that high speed simultaneously. That's a different equation from bandwidth, is it not?

Dr. KALOS. I identify bandwidth and speed in that sense.

Mr. BOUCHER. All right. Well, we're defining our terms better then.

Mr. Kalb.

Mr. KALB. I think there is another element of research that goes beyond just the raw bandwidth that provides some of the capabilities you're talking about. Quite often when networks are put into place today the early implementations will achieve less than 10 percent, sometimes only 5 percent, of the usable bandwidth, and there is a significant element of research that goes into getting high packet rates and high effective utilization of what is theoretically a high bandwidth wire.

And that—those are two very distinct elements, and we need to keep those in mind as we move forward, frankly.

Mr. BOUCHER. Thank you. That was my sense as well.

Dr. Weingarten.

Dr. WEINGARTEN. I'd like to make a couple of points. One, I think at the level of network—we can talk about networks at many levels, from physical infrastructure to user organizations. At the level at which speed is a determining factor, to my knowledge almost the entirety of the network is already commercially provided. This is in some sense at that level not really an issue. Those facilities are all contracted from the private sector already.

There is very few cases, I think, where NSF has actually—if any, where NSF has gone out and strung wire or done anything of that sort.

Mr. BOUCHER. Well, let me interrupt you to say that I think you're right. The NSF hasn't been wiring fiber optics from point to point. That is privately provided. But what I understand the NSF has done is provided the funding necessary to develop other networking technologies—higher speeds of switching, software development capable of routing the information and greater volumes of information at those higher speeds, and that is essential to the operation of a higher capability network than the private sector currently provides on its own, don't you agree?

Dr. WEINGARTEN. I believe that's—yes, I agree. I believe that's so, and in many cases those research projects I think are done in conjunction with Bell Labs, Bellcore, and, in fact, the private sector.

I would like to make a comment from CRA's perspective as users of the network to perhaps convey why the community is a little nervous about some of this. Today, using the Internet I could reach out and touch virtually anybody in my community almost instantly, unless they are in the emergency room in the hospital. In some sense the network in computer science has become an international seminar room in which any of us can talk with anybody else on any subject at anytime, exchange software, exchange data, exchange papers and ideas, and collaboratively work on research projects.

It's an environment, and my members feel particularly concerned with any idea when that environment start to be partitioned. The science has really changed over the last 5 to 10 years because of the Internet. The entire structure of how we do research is now dependent on this, so we're quite concerned about tinkering with it in ways where we can't see the future, and I think that's a legitimate concern.

We're also very sensitive to the fact that the—we now nationally decided that we want to build an advanced national information infrastructure and in no way want to see the Internet or NSF activities or government activities in any way impede the development of that in the private sector. in fact, we need those facilities so that the private sector will be developing.

May I make a short-term strategic comment on the strategy? One possibility—in the first place, we think section (b) really very clearly spells out the concern of Congress that that interference not take place. This Committee and the CRA would like to see the bill out as soon as possible. We understand there are some deep differences of opinion between the communities, between the telcos and the research and education community. And I would suggest that this Committee or the Congress more broadly mandate that the communications industry and the research and education community get itself together, find the area of common agreement, because, coming from OTA I believe we have more in common than we have in difference, if we were forced to discuss this out and in a given period of time—perhaps 6 months, 9 months—come back with an implementation plan and a set of operational policies that serve both needs.

Mr. BOUCHER. That's a useful suggestion. We're having discussions even now between those two communities, and hopefully, we'll have an agreement on legislative language within the course of the next week. That's certainly our goal.

Obviously, the finer details of implementation of this transition are going to require more specificity than can be provided within a week, but we're certainly moving in the direction of filling this hole in the statute which we have at the moment.

Let me ask you this question, and this is really in response to the comments that were raised by Mr. Johnson at the start of this hearing. He suggested that perhaps the private sector could do everything that H.R. 1757 is designed to do, and that if we didn't pass this follow-on to the High Performance Computing Act and target applications and areas such as the delivery of health care, education, the digitizing of libraries, and the making available of the stores of government information, that all of this somehow might happen just with private sector investment within a timeframe that is appropriate and suitable.

What are your comments with regard to that suggestion? Do we need this legislation at all? Mr. Kalb?

Mr. KALB. Well, I think that Mr. Johnson's comments about the fact that it would happen are correct. What I think is under consideration here is the fact that most of us see the advent of this high performance communication and computation as being a tremendous economic benefit to the country, creating jobs, creating competitiveness, et cetera.

The real question is when do you want it? How fast do you want it? Not whether you want it. Yes, we can let it go and it will happen. The question is when do you want it? When do you want this extra competitiveness and so on? And I think it is just as simple as that.

Mr. BOUCHER. And so your conclusion is that we need to pass this in order to get these advances within an acceptable timeframe?

Mr. KALB. That's exactly my conclusion.

Mr. BOUCHER. All right. Others like to comment on that? Yes, Dr. Masi.

Mr. MASI. Yes. I absolutely agree. The computer industry is probably, I would say a net positive generator of profits, taxes, to the United States export revenue, and so forth. Government working with a university was responsible for the computer industry, and year after year after year we see technology flow into the business computing market that came from the high performance computing market. So I think judged on an economic basis it will stack up as an excellent investment.

I took some of the comments to also be reflected against the high performance computing and communications initiative of 1991 as well. So my feeling is it's an excellent investment and will compare quite well with any other government investment that's been made.

Mr. BOUCHER. Thank you. Yes, Dr. Weingarten?

Dr. WEINGARTEN. I would add one more argument to that set. If it were to occur without legislation of this sort, it's not clear to me that the broader public interest needs of our society would all be met. This bill focuses very directly on some—certain kinds of needs that may not provide a sufficient market force to move the technology.

Mr. BOUCHER. Mr. Gage.

Mr. GAGE. In this connection I would comment the—it's a necessary thing for the high level, the high standard of interoperability to make all—an example, in health care. If each separate health institution attempts to institute something, they'll cobble something together. It will be quite inefficient when it comes time to take economies of scale and transferring a child's vaccination records or all the problems in unifying data bases. There is a very strong role for a government position in integrity of data and in interoperability of systems.

On the competitive front, we dominate the Japanese market, perhaps a billion dollars, almost a billion dollars of sales into Japan annually coming from Ms. Eshoo's district, and this is accomplished by use of the network and by adherence to common standards that allow software to be developed that's multilingual.

This is an aspect of the network which, in fact, requires a great deal of effort. We've been an anglophone network for a long time, or at least a European character set. It's quite important in the furtherance of technology to have access to the best work. The Japanese patent office, for example. The U.S. Patent Office is searched regularly by everyone in the world. Searching the Japanese patent office is quite useful in technology transfer in the other direction.

There is no container of high technology. The United States does not bottle up everything good in the world. I think if you look at the list of names along this table you'll see a variety of origins of people that contribute to the U.S. economic well-being. So certainly in our engineering organization that's the case. So international cooperation on the network is important.

Mr. BOUCHER. Thank you. Dr. Kalos?

Dr. KALOS. I would say that of all the activities promoted by H.R. 1757 the reform of education and its universal access, high quality education to all of the children of the country require wise governmental intervention. It cannot be left simply to the private sector.

Mr. BOUCHER. Does anyone disagree with this train of thought? I don't see any hands raised.

Yes, sir, you had asked to be recognized.

Dr. DIFFIE. Let me make two quick points. One is on the previous issue; that is, it's not clear to me that the testbed function is well served by vetting all the traffic against criteria of appropriateness. A real network doesn't have that luxury, and so you may find that when you take your testbed high speed technology and then turn it over for commercial development suddenly you find the testbed did not model the real world.

So, although I recognize the value of not competing against private communications providers, I also caution that we should be careful not to reject traffic in such a way as to legislate out our, say, congestion problems.

Mr. BOUCHER. You've got to have a sufficient critical mass of traffic on the high speed network in order to test it sufficiently.

Dr. DIFFIE. Test its high speed; yes.

My other point is strongly in support of this educational initiative. I've been worrying for several years about the following problem.

When I was a teenager I happened to be a moderately precocious researcher, and I had the very good luck to have access to such resources as the New York Public Library. But at that time I rather fancy that the advantage that professional researchers had over me was, in fact, minimal. They had more experience in using the library, but I had the same library resources available to me. I could sit there in the reading room at New York Public and find the resources I needed.

I think today I would be in a much more difficult position because without a budget to use the major data bases that are an essential component of research I would be in a qualitatively different position from the positions of adult and professional researchers, and I think that drawing young talent into the process is one of the most essential functions, and one of the most dangerous places that we could develop a bottleneck.

Thank you.

Mr. BOUCHER. Thank you very much for those thoughtful remarks.

Ms. Eshoo, would you like to ask some additional questions? I'd be happy to yield to you if you would like.

Ms. **ESHOO**. I just wish, Mr. Chairman, that more of our colleagues had been here this morning. I've been to—attended and been a part of several hearings since coming to the Congress. I have to say that this has been the most stimulating one of all, and I want to thank you again.

Let's see. I did have some more questions. What did I do with them—that I jotted down. Well.

I wondered if you could comment on the agencies—ARPA, DOE, and there's a third, that is involved in all of this. From your experience, are these the correct agencies to be carrying this out? And if not, what are your ideas? And if you agree that they are, perhaps your experience can tell us why.

Mr. **BOUCHER**. Dr. Lindberg.

Dr. **LINDBERG**. I'd like to respond to that question. Historically, this project really started with sort of the Big Four science agencies—DOD, DOE, NASA and NSF—and then subsequently after the—immediately before the project became an official crosscut a second tier, so to speak, of agencies were added that are much smaller participants in the program, although many are major-size agencies; for instance, HHS, EPA, Commerce with its two science labs, the National—NOAA, the weather agency, and NIST, the National Bureau of Standards, or former National Bureau of Standards, and then Department of Education, then NSA from Department of Defense. So those all joined as a second tier.

Now, are they the right agencies? I think that they are, but I think that it is absolutely essential that this second wave of legislation pointed at applications pass and get funded or all of those agencies will be merely spectators. I mean, for instance, you've spoken—the panel has spoken about, I believe correctly, the tremendous importance of education and training. That's probably the long-term real gift to the country that this activity will engender.

I think that the level of funding for the whole Nation of this activity for the Department of Education is $2 million. So I think a lot of adjusting has to be done.

And I want to give you one other positive aspect of this, though. Through the meetings of the HPCC Committee we've engendered a new project having to do with climate modeling and weather prediction. Now, if you'll remember, Department of Energy is already—and NSF, are already taking an interest in climate modeling, but on the other hand, it's the job of NOAA to actually predict weather and they did such a wonderful job with Hurricane Andrew and so forth.

OK. The project has now emerged to utilize NASA with its ability to gather data, Department of Energy with its ability to transmit it on the ground, NOAA and its formulation of the mathematical models that predict the weather, and NSF and its funding of the basic mathematics behind those models. So that what is emerging is a new project with all of those agencies playing, we feel, a very, very proper role in eliminating the duplication and getting a job, an important job done better.

So I think adjustments to the division of labor between the agencies and better funding of those that are interested in applications will bring you what you want.

Mr. BOUCHER. Thank you. Thank you, Ms. Eshoo.

That's a very thoughtful question, because I am interested too in knowing whether the allocation that we have provided first in the 1991 legislation and that we are continuing essentially through H.R. 1757 among the various agencies is proper. Do we have the right kind of balance here? Are we allocating funding in the right proportions with the rights tasks targeted in view of the fundamental missions of these various research agencies? Would anyone like to comment on that?

Mr. Kalb.

Mr. KALB. Yes. The one area that I would submit is perhaps underfunded, or at least should get a greater portion of the funding, is the monies that are being directed towards the education and training of people to program and utilize these systems. There is some funds allocated in this direction, but it has been our experience, particularly in the massively parallel and very high performance computing systems that the number of people around who can meaningfully use these systems is very small. And, if we were to, you know, focus more effort towards training people to use these technologies, it would not only make this program itself go better, but then as those people diffused into industry we would see applications based on this, we would see new businesses, and so on.

And this is one of these areas, I think, where the fundamental mission of government to train and so on is very much in sync with the need of industry to have these people—industry will hire those people and in turn will present new opportunities for jobs, applications and so on.

Mr. BOUCHER. Dr. Kalos.

Dr. KALOS. I'd like to second what Mr. Kalb said. I believe that some of the most significant training and education in this very important area occurs in the course of the research that is being done now in computational physics, and to the extent that—or computational science, and to the extent that that is done, as it should be, with the most advanced parallel computers, what emerges are people who are experts in research, understand these computers from the perspective of applications, and normally then go on to find jobs in industry.

Mr. BOUCHER. Okay. Let me inquire as to a very specific matter, and, Dr. Lindberg, I want to draw on your experience at the National Library of Medicine for this answer.

One of the things that we contemplate in our bill is an application that is directed toward the digitizing of libraries, and what we have in mind is the transference from printed material into electronic form of the millions of volumes that are on the library shelves around the country. Give us, if you would, some indication of the extent to which this is happening today, and I understand that it is happening at your library, perhaps, at a faster pace than it is in some other places. And tell us about how accessible that information is with the current state of our networking art.

Can a doctor halfway around the country obtain access to information from the National Library of Medicine simply by calling that up on his PC? Give us some sense of where that stands today.

Dr. LINDBERG. OK. I'd be happy to, Mr. Chairman.

A doctor can, in fact, call up a search at the National Library of Medicine through the entire, at least periodical scientific literature of some 15 million articles, and in seconds using a user friendly software called Grateful Med and either an IBM-style PC or an Apple get that search. He or she can read an abstract of the article, can then decide if the individual wants a copy of it, and with one stroke of the finger request that article and have it delivered either by fax in minutes, by courier, or by postal mail. Amazingly enough, what most people actually do is they choose an item on the menu called "I'll stop by the Library on the way home and pick it up myself." [Laughter.]

Mr. BOUCHER. Well, suppose that doctor has——

Dr. LINDBERG. This works pretty well. I mean there are limitations, of course.

Mr. BOUCHER. Suppose the doctor has a laser printer next to his PC. Does he have the option of printing that article out on his PC—over the line?

Dr. LINDBERG. We haven't taken the option of keystroking everything in the world worth knowing. I mean that turns out to be an experiment that two commercial outfits, BRS and Mead Data Central, tried about 10 years ago, and I worked with both of them on the project. It turned out to be very expensive. It was technically possible. They withdrew from the market, not on the grounds that it wouldn't work and they couldn't make money, but they could make more money on a financial product.

So we've left it at a question of page scanning and fax, so that the Internet will give us FAX IV and that's a big, big improvement. Previous to going into that in any kind of a big way we need to solve—we need to deal with, accommodate the intellectual property rights issue; namely, that these matters are copyrighted. The abstract and the citation are not, but the body of the material certainly is copyrighted. So that has to be dealt with.

We're very enthusiastic, however, about pressing on with that in some experimental arrangement which would be fair to copyright holders till that gets worked out.

I should add one other thing, though, Mr. Chairman. You didn't ask the really embarrassing question, which is what percentage of American doctors actually know about and utilize the system? That's a tough number to come up with. We know a great deal about our users and not so much about our non-users. But I don't think anybody believes that more than 20 percent actually utilize the system.

So we have—our top priority really is outreach.

Mr. BOUCHER. What do you do to try to——

Dr. LINDBERG. And I think that's probably going to be true with high performance computing, too.

Mr. BOUCHER. You're probably right.

What do you do to try to advertise your services?

Dr. LINDBERG. Well, everything legal. [Laughter.]

Dr. LINDBERG. But I, I don't like to say that the product is so good that it sells itself, because I think that's probably not a good sales approach.

Mr. BOUCHER. Well, I would think the AMA would be a useful vehicle to help disseminate information about the availability of that resource.

Dr. LINDBERG. Actually, AMA had their own network, and they lost so much money with it that they quit. They encountered exactly the same problem.

Outreach is very important, and we do that largely through the National Network of Libraries of Medicine and the medical librarians of the country.

Mr. BOUCHER. Tell me about formatting compatibility. Obviously, you have a format that you utilize for digitizing data at the National Library of Medicine. I would imagine that other libraries use other formats, and to what extent are these formats compatible so that someone who is a little less specialized than a doctor who is roaming around libraries throughout the country using his PC can with a set of commands access the electronic index of these various libraries. What kinds of compatibility problems do we have today?

Dr. LINDBERG. That's a very interesting question, and you're right. We did start early. In fact, we started in 1964 with print products and 1970 with time share, so we did establish a kind of a de facto standard which now is being overtaken by events. I think because a lot of people want just what you suggested there are a variety of software products existing on the Internet, many in the category, I guess you would say freeware. WAIS, which was donated, I think, the Machines Corporation; Gopher, which was donated by University of Minnesota, are a couple.

There are thousands of these stations in use. Generally speaking, they use a less sophisticated level of searching than we provide, but it is—it does cross, of course, many thousands of knowledge sources. So probably that will overtake events and we may back up to what is an emerging standard called Z3950, which probably will be a national and international standard that everybody can comply with.

Mr. BOUCHER. And this standard is evolving naturally on its own?

Dr. LINDBERG. Well, it's evolving through the proper standard agencies and that's supported by the government. We are members of the committee as well. I mean there are processes whereby that happens.

ASN.1 is another standard that's utilized for the molecular biology data. So I mean there is an infrastructure that takes care of that.

Mr. BOUCHER. We provide in one section of the legislation a direction that standard-setting take place, and to the extent that research is necessary in order to elevate the capability of that standard we provide funds for that as well. Is that an appropriate position?

Dr. LINDBERG. I think it very appropriate. I think it also responds in part to Representative Eshoo's question earlier of what should be done to be sure we don't fossilize overnight and settle for what's only available now. And I think the answer is that as far as the government is concerned it ought to continue as NSF does right now to buy services and not facilities, and insofar as possible not specify standards in their purchasing. I mean we don't, and by and large, so far the industry has overperformed. And where there have been complaints, it's company A complaining that company B is moving too fast.

I mean the progress has really been remarkable, and it's greater than any of us imagined. But we definitely—there is absolutely nobody in the government side of HPCC that wants to see the government own a post and telegraph system. We don't want that at all, and at present nobody—the government doesn't own a single switch and doesn't want to. So we ought to make sure that we continue to buy services and not facilities, and that will help a lot.

Mr. BOUCHER. Good. Mr. Kalb.

Mr. KALB. Yes. I'd like to second the comment about the need for standards in this area, and I think it's a very appropriate investment. We recently had a fellow from NASA Ames come over to our place to show us a demonstration of a prototype he's building for accessing these various libraries and based on library science using present techniques, and the thing that did strike me was that he could get to a number of libraries around the Nation, but if you didn't know your way around, if you didn't know how to make the detailed little connections and things like that, and know how to work with different standards of readability and things like that you were lost.

I couldn't follow him. I watched in amazement as he navigated through this network, but I can't imagine the people that we're talking about getting on the network and doing this.

The National Library of Medicine has been working on this a long time and I suspect they are light years ahead of where most of the libraries are individually, and then collectively I don't think there is a lot of standardization from what I can tell.

Mr. BOUCHER. OK. Other comments? Mr. Gage.

Mr. GAGE. This is an extremely important point because after you have these networks and after you write things and you put them away how do you find them again? Most computer people don't read, so there's not much library experience. The library community in standards such as the Anglo-American cataloguing rules deals with how you find things. How do you—what's a lawyer? A lawyer is a search engine that knows how to find things. So these are very difficult problems.

To go to Representative Eshoo's comment or question about what other institutions have resources available, the single largest depository of stuff to read is inside the intelligence agencies, and there when you put something away, whether it's the Albanian Times or whatever you intercepted last night, you have to find it again if you're going to go argue about where to go kill the right people or whatever the appropriate discussion is. So the results of quite a lot of accumulation of information in the search is an area of the most intense research, and how does one—the normal search engines you use today, define one word within five words of that other word and generate the full text, are extremely primitive. You'd like to be able to say I'd like to find something that is about this topic. No, that's wrong. Get me something that's more like what I really mean.

And those search devices—waste was mentioned—are evolving extremely rapidly now. That's an area of—in fact, how do we read our mail is probably the most single important thing facing anyone on the network, and any additional research in that area which combines bibliographic retrieval, simple questions like how do you really spell Dostoyevsky? Well, you don't do it the same way in France as you do it in the United States. So, if you attempt to find something in a different country, then you have a difficult time. So unifying bibliographic standards, in view of the enormous flood of information, is a major area here, and here is where there is another international component of this.

The only people crazy enough to spend $2 billion on a national library project are the French, and the Bibliotheque de France project will allow some innovative research in areas which we simply have not adequate funds to accomplish. And so linking the very advanced work at National Library of Medicine with the work in other countries to attempt to put things away and find them should be an emphasis in this legislation.

Mr. BOUCHER. Yes, Dr. Herron.

Dr. HERRON. One thing that no one has mentioned yet, I don't think, is that there is a need to be able to share much more than just text. And, of course, all of the text isn't available yet, but in carrying out research and visualizing scientific results and sharing those results, and also communicating a lot of other kinds of pictures, you need to have ways to transfer large amounts of data corresponding to scientific visualizations, photographs, charts, graphs, tables, and these things are great treasure troves of information, but most of our information retrieval software doesn't deal with that at all.

Mr. BOUCHER. OK. Mr. Gage, let me return to a point that you raised earlier—in fact, it was central to your testimony—concerning network security. It was mentioned by Dr. Lindberg in terms of developing a regime whereby intellectual property rights can also be protected.

We have a section in the bill which is fairly cryptic and basically says that research and development funding will be provided network security purposes. Do you have any recommendations for us on how we might be somewhat more elaborate in accomplishing that goal? Are there other provisions that we should have beyond that, or is that in and of itself sufficient?

Mr. GAGE. I will defer to Dr. Diffie on this, but I think that's just, cryptic just—I'm fine. You don't want to be too detailed. We are moving into a regime now where a generation text and there are several—two other categories that are extremely important. One is molecules. Those are described now in databases. So how do you find the molecule you want? How do you find the mirror image of the molecule you want? How do you specify that, see it on the screen, interact with other molecules in these simulation programs? Very serious database search problem.

Secondly, how do you find and use smart drawings, and by that I mean when someone at a community college designs a circuit board and simulates it on a very fast computer somewhere on the net it's every length of the wire, every transistor is simulated. It's a drawing which could just be via touch of a button turned into a device. How do you find those? How do you search them?

Now, this is new intellectual property. How do you protect this? I believe we need to look at a regime where copyright really has not much meaning anymore. I mean what's a copy when everything in the computer is a copy. It's inherently ill-defined.

In the future the generation of new text, molecular design and smart drawings, computer-aided design, will be created and will remain in computers, and transferred and copies and moved around the net instantly. So the access to that data provided by copyright, that is, give us a copy and let us make it available for the elevation of general knowledge, becomes much more difficult. People will stop saying they will take advantage of a copyright to go get the money for their intellectual property and instead rely on contract.

And I think we will see an alteration in the legal regimes around the intellectual property, and I assert, and I have deep arguments—or not deep, but frequent arguments with Dr. Diffie. But the application of public key encryption, in fact, allows us to change the regime of control of publication. I can encrypt it just for you and I can control whether you read it or not by altering the keys in which I encrypt. The New York Times and Washington Post could make editions specifically for certain people, and this allows us, I think, to rethink the regimes of intellectual property.

Mr. **BOUCHER**. Well, it seems to me that that raises a lot of intriguing questions that go beyond the scope of this bill such as whether we need a whole new regime of copyright protection especially geared to information that is stored and transferred—stored in computers and transferred across computer networks, and if you've got any thoughts about the extent to which we ought to do that. One of the other burdens that I bear around here is serving on the committee that has copyright responsibility, so we can take that up in another forum.

But I gather that for present purposes you find our rather cryptic provision with regard to R&D on network security to be appropriate? Dr. Diffie.

Dr. **DIFFIE**. Well, let me see. I want to say that I never argued with Mr. Gage that cryptography couldn't be applied to these problems. I think what I pointed out was a paradox. That digital data have an essentially zero marginal cost of production, and that if other things like food or land had that property, we'd dream that we wouldn't have wars.

And I don't question the value of copyright in allowing people like myself to make a living as authors. But I think that we now have a wonderful new phenomenon, and we should try to avoid chaining it merely because we happen to know how to bill for things that were expensive to manufacture. And I'd very much love to come and discuss this in a forum that's devoted to that.

On the subject of the language in the bill with respect to computer security, I have to say I did find it a little cryptic. I spent some time studying it with people last night. But let me just make a very broad comment about this. That the most—the traditional view of communications security has been that it's sort of an arcane security technology that's only of value to the military, perhaps, and some people with very, very big secrets to hide.

And I want to submit to you, and this is expounded in the written testimony, that the most important security measures you ever take in your life have nothing to do with guards and badges and walls and doors; that you recognize your family and your friends and your colleagues; that you sign your signature to the bills, to checks, to documents, to letters; and that you hold private conversations, and that these are not arcane things. These are the very fabric of human intercourse. And that the NREN is going to be a testbed for what amounts to the fabric of future society. So the decisions we make on these seemingly rather technical points today are actually going to shape the structure of tomorrow's society and really going to determine whether we continue to have what we regard as a free society or whether it evolves into something where these technicalities somehow by-pass the principles on which the country was founded.

And so I just want to emphasize to you I think this is an exceedingly important issue here, both in practical terms like protecting our networks from things like the invasion of 4 October 1988 by the Morris worm, and in protecting the rights of individuals to make use of these new resources to stay in pursuit of the same basic principles which they have always pursued using intellectual resources.

Thank you.

Mr. BOUCHER. I thank you for that statement of lofty vision. It inspires us even further toward this undertaking.

Dr. Weingarten.

Dr. WEINGARTEN. Yes. In fact, I would like to follow up on that a bit less we seem to be just promoters of overly rosy technological visions of the future. As Dr. Diffie said, we are really talking now about changing the basic fabric of our society the way we change—we exchange, create and use information, and that in so many deep ways is almost the definition of what a society is. It's how we relate together. And there is a host of issues that we need to face as we engage in this kind of technological transformation—privacy, intellectual property, access, and freedom of speech—a whole host of information policy issues that we need to face and that need to accompany any program of development of this technology.

So we certainly commend that section of the bill: In fact, if anything, would broaden it to cover these other issues.

Mr. BOUCHER. Well, that is a fascinating set of suggestions and we certainly are going to look at the network security section in somewhat greater detail and take these comments into account as we move toward mark up of the measure.

I just have one additional question to ask, and then we'll need to adjourn the hearing. I have to go over to the National Academy of Sciences this morning to give a speech on the high speed network, of all subjects. So.

Before doing that, let me ask you this. Let's talk little bit about Japan and the Japanese market with respect to supercomputers. To what extent today are the supercomputers and the supercomputing technology that is manufactured in the United States made available in the Japanese market? I understand it has been relatively open but that now Japan may be developing this industry on its own, with government support, and that that might have some effect on market closure.

And, as you answer this question, comment, if you would, also, on the extent to which the Japanese government is directly supporting the kinds of activities in Japan that we are seeking to support through the High Performance Computing Program here in the U.S.

Yes, Mr. Masi:

Mr. MASI. In fact, I'll be going over there next week. It's unfortunate this hearing wasn't a week after.

But the openness of the Japanese market to U.S. supercomputer/high performance computer companies has been limited at best. It has been relatively open in the commercial sector, and it has been not open in the private—excuse me—public sector.

That is not to say that there haven't been on occasion pieces of public sector business that have been awarded to U.S. companies. They were done without—quote-unquote—fair and open competition. Now, essentially, I'm expressing my opinion, obviously, but a number of years of experience dealing within the Japanese market. They were essentially set-asides. In situations, public sector situations where there have been competitions the U.S. vendors have found a very difficult time to compete.

Now, commonly the Japanese computer vendors will cite the U.S. market as the same example of having barriers to entry. Yet the commercial market in the U.S. is free and open. And it was in the fall of 1984 when Amdahl Corporation, I believe, began to market Fujitsu's supercomputer in North America, and it's 9 years later and there may be 2 or 3 commercial companies within North America utilizing Japanese supercomputers.

So the free and open market, certainly the commercial market has not thrown up barriers in the U.S., nor for that matter in Japan. So I do not agree with some of the arguments that have come from Japanese computer manufacturers.

I think we're potentially facing a third, I'll call it incubation phase, within Japan. The first one started with IBM-type products and the Japanese recognition of the need to develop a domestic computer industry. I'd say that the second incubation phase occurred in the mid-80s with Cray Research, Inc. attempts to realize only a fraction of the market successes in the public sector they enjoyed both in the United States and in Europe, and within the last—I think it was yesterday or the day before, the third prominent Japanese computer company finally announced a "MPP" system. So now all have announced systems.

And what I'm hoping doesn't occur is a third incubation phase where realizing that the leadership gap is increasing between the Japanese computer manufacturers and those in the United States that there is not a period where it becomes very difficult for U.S. American-based companies to be successful in the Japanese market.

Mr. BOUCHER. Can you talk a little bit about the extent to which Japan is providing government support for the development of a new generation of supercomputers and also the high speed networking technology?

Mr. **Masi**. No, I do not have specific information on that. I only have general information. So, perhaps, others at the table have more specific information.

Mr. **Boucher**. Okay. Let's call on other witnesses. Anyone want to comment on that particular question? Would anybody else like to comment on the general openness of the market? Mr. Kalb.

Mr. **Kalb**. Yes. There was, you know, the Fifth Generation program that came to a conclusion last year or the year before in which the Japanese government was a major player in trying to develop new technologies. There is a new program that is being put in place in which they have actually called for international participation from other companies, but I think that's been very limited to date. So the Japanese government, from my knowledge, has been investing reasonably heavily into some of these areas and providing a significant coordination function.

I would add to Mr. Masi——

Mr. **Boucher**. Could I just stop you for a second and ask this? The Fifth Generation program, as I understand it, was loosely characterized as artificial intelligence. Did that involve massive parallel processing the way that our supercomputer program does?

Mr. **Kalb**. Yes.

Mr. **Boucher**. And what were the results of the investment? What did they produce?

Mr. **Kalb**. Well, it did involve massively parallel systems, or parallel systems in general, because their concept was that they needed to build these very powerful systems in order to execute the artificial intelligence programs. The results were not particularly good. In fact, I have heard it characterized as that there were some embarrassments that came forward from that, which, if anything, probably has to this point anyway delayed some of the major computer corporations from making a new investment. They seem to have gotten over that now very quickly and are moving forward in the massively parallel area.

I think the danger for American companies historically comes from the fact that the Japanese market does a switch in the middle. When the Japanese market has traditionally not had an alternate product, and this has been well-documented with chips and various other systems, you can make some level of progress. As soon as there has been a competitive product in these very important strategic areas, there's this major switch in policy.

I know Intel documented this on things like the 8080 and stuff where they had essentially control the market and 2 months later they were out of business, literally, in those particular fields. And so we haven't gotten to that point yet, even though I think there is some foot dragging in terms of buying the massively parallel computers. But the danger will come from an American market standpoint later down when there really are viable competitors. And maybe it will stay open this time, we just don't know. But history says it hasn't.

Mr. **Boucher**. We should watch that development very closely.

Are other members of the subcommittee seeking recognition at this time? Mr. Barcia.

Mr. **Barcia**. Thank you very much, Mr. Chairman. I apologize for my tardiness in the Subcommittee this morning, but I do have a conflict with the Subcommittee on Water Resources. They are discussing the reauthorization of the Clean Water Act this morning. But I would like to make a statement, Mr. Chairman, and thank you for holding this hearing and thank the distinguished members of the panel for their testimony, and say that I do have a request for the chair. And would ask for unanimous consent of the committee to submit testimony on behalf of the Consortium for International Earth Science Information Network, based in my Fifth Congressional District back in Michigan, and also request an additional 5 legislative days to submit it to the Subcommittee.

Mr. BOUCHER. Without objection, that time will be granted and we will receive that testimony for the record.

Mr. BARCIA. Thank you very much, Mr. Chairman.

Mr. BOUCHER. Thank you very much, Mr. Barcia.

I don't have any further questions. Ms. Eshoo, anything?

I would like on behalf of the Subcommittee to express our appreciation to all of you for being here this morning. We've been at this 2½ hours. It's been extremely interesting to us and very informative, and we will take into account all of your recommendations, written and oral, as we move this measure toward enactment during the course of this month.

With the Subcommittee's thanks to these witnesses, this hearing is adjourned.

[Whereupon, at 11:30 a.m., the subcommittee was adjourned, to reconvene subject to the call of the chair.]

APPENDIX

SUBCOMMITTEE MARKUP OF H.R. 1757—THE HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993

THURSDAY, JUNE 17, 1993

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Science,
Washington, DC.

The subcommittee met, pursuant to call, at 10:11 a.m., in room 2318, Rayburn House Office Building, Hon. Rick Boucher (chairman of the subcommittee) presiding.

Mr. Boucher. The subcommittee will come to order.

This morning the Subcommittee on Science is meeting for the purpose of marking up legislation on H.R. 1757, the High Performance Computing and High Speed Networking Applications Act of 1993. The Chair now calls up H.R. 1757, the High Performance Computing and High Speed Networking Applications Act of 1993.

The original bill and an amendment in the nature of a substitute are before the members. An explanation of the differences between the two versions of the bill is also before the members.

[The information follows:]

SUMMARY OF DIFFERENCES BETWEEN H.R.1757 AS INTRODUCED AND THE BOUCHER SUBSTITUTE AMENDMENT

The Boucher substitute amendment makes the following modifications to H.R. 1757, as introduced (bill section references are for the bill as introduced):

1. The short title of the bill is changed to the "National Information Infrastructure Act of 1993".

2. A requirement to promote development of interconnected and interoperable information systems is added to the provision [Sec. 301(c)] which establishes the applications program.

3. The requirement for the OSTP Director to appoint a member of his staff as coordinator for the high performance computing and applications programs [Sec. 304] is deleted. The Administration recommended this change because a coordinator for the program has been appointed (Dr. Donald Lindberg, the Director of the National Library of Medicine) and the provision would limit the Director's flexibility in allocating his staff's responsibilities.

4. The network connections program [Sec. 306] is modified by requiring that the National Telecommunications and Information Administration (NTIA) participate in implementing the program. A three-year authorization is provided for NTIA: $54 million for FY 1994, $150 million for FY 1995, and $150 million for FY 1996. The authorization for NSF is reduced and changed from five to three years: $15 million for FY 1994, $30 million for FY 1995, and $50 million for FY 1996.

5. Authorized research activities for support of applications [Sec. 307] are expanded to include research in the social sciences and research to provide the means to manage and protect copyrighted information. The five-year authorization for this section is reduced from $141 million to $81 million.

6. The five-year authorization for the education applications [Sec. 308] is reduced from $364 million to $271 million.

7. Support for basic research leading to new technologies with clinical uses is added to activities authorized under applications for clinical information systems [Sec. 309(b)]. The five-year authorization for health care applications is reduced from $364 million to $328 million.

8. Authorized activities for library applications [Sec. 310] are expanded to include the development of mechanisms for protecting copyrighted materials in electronic form. The five-year authorization for this section is reduced from $245 million to $152 million.

9. The requirement is added that the President designate a lead agency to implement authorized activities for applications for government information [Sec. 311] and to issue policy

guidelines for relevant federal programs. The five-year authorization for this section is reduced from $118 million to $74 million.

10. The amendment to the High Performance Computing Act (HPC) of 1991 regarding the advisory committee [Sec.4] is modified to designate the OSTP Director, rather than the President, as the appointing official for committee members. In addition, a new provision is added which requires the committee to meet at least annually to receive public testimony on the planning and implementation of the applications program and to provide a report to Congress and the OSTP Director on its findings and recommendations.

11. The amendment to the HPC Act of 1991 regarding the National Research and Education Network [Sec. 5] is modified by replacing the 18 month delay in imposing restrictions on use of federal experimental test bed networks with a date specified by the OSTP Director, which shall be the earliest date on which implementation of the restriction is technically feasible. Also regarding the restriction on use of test bed networks, factors are specified which are to be used in determining whether commercial network services are satisfactorily available. Finally, a provision is added to require that data communications networks developed under the Act be through purchase of standard commercial services whenever feasible.

12. The provision for establishing an additional associate director at OSTP for overseeing federal efforts to disseminate scientific and technical information [Sec. 6] is deleted, consistent with the recommendation of the Administration.

Boucher Substitute for H.R.1757

Authorizations by Program

$ millions

PROGRAM	FY94	FY95	FY96	FY97	FY98
Connections:					
NTIA	54	150	150		
NSF	15	30	50		
Research for Applications	6	15	20	20	20
Education (NSF)	16	45	60	75	75
Health (HHS)	22	54	72	90	90
Libraries:					
NSF	8	16	22	32	32
NASA	4	8	10	12	12
Gov't Info	4	12	16	21	21
TOTAL: [1359]	129	330	400	250	250

SECTION-BY-SECTION ANALYSIS OF THE BOUCHER SUBSTITUTE AMENDMENT TO H.R. 1757

Section 1. Short Title.

The short title of the bill is the "National Information Infrastructure Act of 1993."

Section 2. Findings.

The bill cites the opportunities and benefits to society of developing applications of computing and networking technologies resulting from the R&D activities under the High-Performance Computing Act of 1991. The need is expressed for a coordinated, interagency program to develop such applications for the benefit of society.

Section 3. Applications of the High-Performance Computing Program.

The bill amends the High-Performance Computing (HPC) Act of 1991 by adding a new Title III having the following sections:

Section 301. Establishment of Applications Program.

The Director of the Office of Science and Technology Policy (OSTP), through the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), is charged to establish an interagency program to develop applications of computing and networking technologies for education, libraries, health care, the provision of government information, and other appropriate fields. The program is required to focus on applications accessible and usable by all citizens, and a plan is required which establishes the goals and proposed activities under the program. The President designates the federal agencies which will participate in the applications program.

The applications program is required to involve cost sharing and partnerships among participating federal agencies, State and local governments, and the private sector. The participating federal agencies are directed to give special consideration to promoting interconnected and interoperable information systems in selecting awards under the applications program.

Section 302. Plan for Computing and Networking Applications.

The five-year applications plan must specify program priorities and goals, agency responsibilities, and funding levels by goal and by agency. Each biennial submission of the plan to Congress must include a summary of accomplishments, an evaluation of progress and problems, and recommendations for needed congressional assistance in implementing the plan.

Section 303. Responsibilities of the FCCSET.

The FCCSET is responsible for development of the applications plan, for coordination of the applications program, and for providing OMB, prior to release of the President's budget request, with an assessment of the consistency with the plan of each participating agency's budget estimate.

Section 304. Notification Requirement.

Each agency participating in the applications program is required to identify for OMB at the time of submittal of its budget request those portions of its budget that are included in the plan or that help support the goals of the plan. OMB is required to review the agency submissions in light of the applications plan and to indicate in the President's budget request the portion of each agency's request that supports the plan.

Section 305. Network Access.

As part of the plan, the National Science Foundation (NSF) and the National Telecommunications and Information Administration (NTIA) are tasked to assist, on the basis of cost sharing, educational institutions at all levels, libraries, museums, and State and local governments to interconnect and to connect to the Internet. In addition, instructional programs are authorized to train teachers, students, librarians, and local government personnel in the use of computer networks and the Internet, in particular. Finally, the OSTP Director is required to provide a report to Congress of an examination of the level of connectivity of schools, libraries, and State and local government offices to the Internet, an estimate of the cost of universal access, and recommendations for ways to expand connectivity.

A three-year authorization is provided for NSF: $15 million for FY 1994, $30 million for FY 1995, and $50 million for FY 1996. A three-year authorization is provided for NTIA: $54 million for FY 1994, $150 million for FY 1995, and $150 million for FY 1996.

Section 306. Research in Support of Applications.

The plan is required to specify research activities to address issues underlying all of the computing and networking applications being developed, including research activities in the social sciences. The plan must address research needed to provide the means to assure network security and privacy, including the management and protection of copyrighted information, and research to develop and demonstrate user-friendly network interfaces.

A five-year authorization is provided: $6 million for FY 1994, $15 million for FY 1995, $20 million for FY 1996, $20 million for FY 1997, and $20 million for FY 1998.

Section 307. Applications for Education.

The plan is required to specify applications for education at all levels. Activities under the plan must include: projects to demonstrate the educational uses of the Internet; development of hardware systems, software and networks for teacher training and informal education; and development of educational software.

The plan is required to include projects which address K-12 education and which strengthen ongoing educational reform activities. Authorized projects include: provision for connections among schools in local regions and for connection to the Internet, addressing the needs of both rural and urban areas; collection and dissemination of effective educational programs available via the Internet; development of undergraduate courses on educational applications of computing and networking for teachers in training; and development of educational software designed for collaborative use over the Internet.

A five-year authorization is provided for NSF: $16 million for FY 1994, $45 million for FY 1995, $60 million for FY 1996, $75 million for FY 1997, and $75 million for FY 1998.

Section 308. Applications for Health Care.

The plan is required to specify applications for use in the health care sector. In the area of clinical information systems, authorized projects include: test bed networks to link health providers in a variety of settings to enable sharing of medical images and records; development of technologies to manipulate and use diagnostic images and records, and basic research leading to new technologies with clinical uses, such as virtual reality; and development of database technology for better access to medical information.

To provide health information to the public, projects are authorized to: develop network and database technologies for distribution of interactive health promotion information; establish pilot programs to develop and to assess the effectiveness and cost efficiency of interactive materials to assist patients in deciding among health care options; develop user-friendly human/computer interfaces for non-specialists in computer technology; and develop technologies to provide individuals with customized health information.

Finally, projects are authorized to develop test bed networks and collaborative technology (1) to enable health and human service providers to work together in delivering coordinated care for at-risk populations, (2) to enable health care providers to obtain on-line access to health promotion and disease prevention recommendations from Public Health Service agencies, and (3) to guide and assist clinicians in providing treatment and advice to patients and to facilitate gathering population data sets on the efficacy of treatments and on national health trends.

A five-year authorization is provided for HHS: $22 million for FY 1994, $54 million for FY 1995, $72 million for FY 1996, $90 million for FY 1997, and $90 million for FY 1998.

Section 309. Applications for Libraries.

The plan is required to specify projects that will allow for development of digital libraries of electronic information. Specific projects authorized include development of ways to accurately digitize, organize and store large quantities of electronic information, including development of means for protecting copyrighted material in electronic form; development of software for searching and manipulating such digital libraries; and development of user-friendly technologies, and associated training of users, for use of networked digital libraries.

Prototype digital libraries, providing public access via the Internet, are to be developed to serve as test beds for the concepts and methods authorized under this section. These prototypes are to serve as assessment tools in the utility and value of digital libraries and of the technologies available for using them. Finally, NASA is required to develop databases of software and remote-sensing images to be made available via the Internet.

A five-year authorization is provided for NSF: $8 million for FY 1994, $16 million for FY 1995, $22 million for FY 1996, $32 million for FY 1997, and $32 million for FY 1998. A five-year authorization is provided for NASA: $4 million for FY 1994, $8 million for FY 1995, $10 million for FY 1996, $12 million for FY 1997, and $12 million for FY 1998.

Section 310. Applications for Government Information.

The plan is required to specify applications to provide improved public access to information generated by federal, state and local governments. The President is required to designate a lead agency for implementing this part of the plan and for issuing policy guidelines for federal activities. Projects are authorized to connect depository libraries and other sources of government information to the Internet and to demonstrate technologies to facilitate use of government information to support research and education, economic development, and an informed citizenry. A specific requirement is included to establish an inventory/locator system for federal information accessible via the Internet.

A five-year authorization is provided: $4 million for FY 1994, $12 million for FY 1995, $16 million for FY 1996, $21 million for FY 1997, and $21 million for FY 1998.

Section 4. High-Performance Computing and Applications Advisory Committee.

The bill amends subsection 101(b) of the HPC Act of 1991, which establishes an advisory committee for the HPC Program. The amendment assigns the responsibility for appointing the advisory committee to the OSTP Director and broadens the scope of the committee to encompass the applications activities authorized by the new Title III. The membership of the committee is expanded to include representation from all parts of the education community and from consumer and public interest groups.

The advisory committee is required to meet at least annually for the purpose of receiving public testimony on the planning and implementation of the applications program and to provide an annual report to the OSTP Director and Congress on its findings and recommendations.

Section 5. National Research and Education Network Amendments.

Amendments are made to section 102 of the HPC Act of 1991, which establishes the National Research and Education Network (NREN) in order to define a revised NREN Program having three components: (1) research and development of networking software and hardware required for achieving gigabit data transmission rates, (2) experimental test bed networks to develop and demonstrate advanced networking technologies and to support applications requiring levels of network capabilities not commercially available, and (3) provision of support for researchers, educators and students to obtain access to and use of the Internet for purposes consistent with the Act. Reports to Congress are required which specify a plan for achieving the goals of component (3) defined above, and which describe annual progress toward implementation of the plan.

Use of experimental test bed networks for purposes other than those specified under (1) and (2) above is prohibited if satisfactory commercial network services are available. This prohibition becomes effective on the earliest date on which implementation is technically feasible. The OSTP Director is required to specify the date in a report to Congress.

A provision is added to require that data communications networks developed under the Act be through purchase of standard commercial services whenever feasible in order to minimize federal investment in network hardware and software.

Section 6. Conforming Amendments.

Summary of H.R. 1757 As Introduced

The proposed legislation amends the High Performance Computing (HPC) Act of 1991 to establish an interagency program for development of applications of computing and networking technologies for education, libraries, health care, the provision of government information, and other appropriate fields. The Director of the Office of Science and Technology Policy (OSTP) is required to develop a program plan, including specification of agency roles and proposed funding levels. The program must focus on applications which are accessible and usable by all citizens.

The following program components are required:

1. Network Access. As part of the applications plan, NSF is tasked to assist educational institutions at all levels, libraries, and local governments to establish local networks and to connect to the Internet (the network of interoperable public and private packet-switched data networks). A five-year authorization is provided for NSF totaling $310 million.

2. Research in Support of Applications. The plan is required to specify research activities to address issues underlying all of the computing and networking applications being developed, especially research needed to provide the means to assure network security and privacy and research to develop and demonstrate user-friendly network interfaces. A five-year authorization is provided totaling $150 million.

3. Applications for Education. The plan is required to specify applications for education at all levels. Activities must include: demonstrations of the educational uses of the Internet; development of hardware systems, software and networks for teacher training and for formal and informal education; and provision for connections among schools in local regions and for connection to the Internet. A five-year authorization is provided for NSF totaling $364 million.

4. Applications for Health Care. The plan is required to specify applications for use in the health care sector, including development of clinical information systems, provision of health information to the public, and development of health delivery systems and population data sets. A five-year authorization is provided for HHS totaling $364 million.

5. Applications for Libraries. The plan is required to specify projects that will enable digitization, organization and storage of large quantities of electronic information; and will develop software for searching and manipulating digital libraries. Prototype digital libraries, providing public access via the Internet, are to be developed to serve as testbeds for these technologies. A five-year authorization is provided for NSF and NASA totaling $245 million.

6. Applications for Government Information. The plan is required to specify applications to provide improved public access to information generated by federal, state and local governments, including connections for depository libraries to the Internet and a requirement to establish a

locator system for federal information accessible via the Internet. A five-year authorization is provided totaling $118 million.

In other amendments to the HPC Act of 1991, the scope of the public advisory committee to the program is broadened to encompass the applications activities, and the membership of the committee is expanded to include representation from the K-12 education community and from consumer and public interest groups. Amendments are made to the portion of the HPC Act of 1991 which establishes the National Research and Education Network (NREN) in order to define a revised NREN Program having three components: (1) research and development required for achieving gigabit data transmission rates, (2) test bed networks to demonstrate advanced networking technologies and to support applications requiring levels of network performance not otherwise available, and (3) provision of support for researchers, educators and students to obtain access to and use of the Internet for purposes consistent with the Act. Reports to Congress are required which specify a plan for achieving the goals of component (3) defined above, and which describe annual progress toward implementation of the plan.

Finally, the bill amends the National Science and Technology Policy, Organization, and Priorities Act of 1976 by (1) adding an additional, presidentially appointed Associate Director for OSTP to oversee federal efforts to disseminate scientific and technical information and (2) adding to the functions of the OSTP Director the task of assisting the President in disseminating scientific and technical information.

SECTION-BY-SECTION ANALYSIS
OF H.R. 1757 AS INTRODUCED

Section 1. Short Title.

The short title of the bill is the "High Performance Computing and High Speed Networking Applications Act of 1993."

Section 2. Findings.

The bill cites the opportunities and benefits to society of developing applications of computing and networking technologies resulting from the R&D activities under the High-Performance Computing Act of 1991. The need is expressed for a coordinated, interagency program to develop such applications for the benefit of society.

Section 3. Applications of the High-Performance Computing Program.

The bill amends the High-Performance Computing (HPC) Act of 1991 by adding a new Title III having the following sections:

Section 301. Establishment of Applications Program.

The Director of the Office of Science and Technology Policy (OSTP), through the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), is charged to establish an interagency program to develop applications of computing and networking technologies for education, libraries, health care, the provision of government information, and other appropriate fields. The program is required to focus on applications accessible and usable by all citizens, and a plan is required which establishes the goals and proposed activities under the program. The President designates the federal agencies which will participate in the applications program.

Section 302. Plan for Computing and Networking Applications.

The five-year applications plan must specify program priorities and goals, agency responsibilities, and funding levels by goal and by agency. The applications program is expected to involve cost sharing and partnership arrangements with non-federal entities. In addition, each biennial submission of the plan to Congress must include a summary of accomplishments, an evaluation of progress and problems, and recommendations for needed congressional assistance in implementing the plan.

Section 303. Responsibilities of the Council

The FCCSET is responsible for development of the applications plan, for coordination of the applications program, and for providing OMB, prior to release of the President's budget request, with a review of each participating agency's budget estimate in the context of the plan.

Section 304. Coordinator.

The OSTP Director is required to designate a member of the OSTP staff to be responsible for reviewing agency activities in order to assess compliance with the goals of the high performance computing and applications programs, for assisting with overall coordination of agency activities, and for providing the point of contact for the programs for Congress and the public.

Section 305. Agency Reports.

Each agency participating in the applications program is required to provide to OMB at the time of submittal of its budget request a report identifying those portions of its budget that are included in the plan or that help support the goals of the plan. OMB is required to review the agency reports in light of the applications plan and to indicate in the President's budget request the portion of each agency's request that supports the plan.

Section 306. Network Access.

As part of the plan, the National Science Foundation (NSF) is tasked to assist educational institutions at all levels, libraries, and local governments to establish local networks and to connect to the Internet. In addition, instructional programs are authorized to train teachers, students, librarians, and local government personnel in the use of computer networks and the Internet, in particular. Finally, the OSTP Director is required to provide a report to Congress of an examination of the level of connectivity of schools, libraries, and local government offices to the Internet, an estimate of the cost of universal access, and recommendations for ways to expand connectivity.

A five-year authorization is provided for NSF: $20 million for FY 1994, $60 million for FY 1995, $70 million for FY 1996, $80 million for Fy 1997, and $80 million for FY 1998.

Section 307. Research in Support of Applications.

The plan is required to specify research activities to address issues underlying all of the computing and networking applications being developed. The plan must include research needed to provide the means to assure network security and privacy, as well as research to develop and demonstrate user-friendly network interfaces.

A five-year authorization is provided: $10 million for FY 1994, $30 million for FY 1995, $35 million for FY 1996, $38 million for FY 1997, and $38 million for FY 1998.

Section 308. Applications for Education.

The plan is required to specify applications for education at all levels. Activities under the plan must include: projects to demonstrate the educational uses of the Internet; development of hardware systems, software and networks for teacher training and informal education; and development of educational software.

The plan is required to include projects which address K-12 education and which strengthen ongoing educational reform activities. Authorized projects include: provision for connections among schools in local regions and for connection to the Internet, addressing the needs of both rural and urban areas; collection and dissemination of effective educational programs available via the Internet; development of undergraduate courses on educational applications of computing and networking for teachers in training; and development of educational software designed for collaborative use over the Internet.

A five-year authorization is provided for NSF: $24 million for FY 1994, $70 million for FY 1995, $82 million for FY 1996, $94 million for FY 1997, and $94 million for FY 1998.

Section 309. Applications for Health Care.

The plan is required to specify applications for use in the health care sector. In the area of clinical information systems, authorized projects include: testbed networks to link health providers in a variety of settings to enable sharing of medical images and records; development of technologies to manipulate and use diagnostic images and records, and development of new technologies with clinical uses, such as virtual reality; and development of database technology for better access to medical information.

To provide health information to the public, projects are authorized to: develop network and database technologies for distribution of interactive health promotion information; establish pilot programs to develop and to assess the effectiveness and cost efficiency of interactive materials to assist patients in deciding among health care options; develop user-friendly human/computer interfaces for non-specialists in computer technology; and develop technologies to provide individuals with customized health information.

Finally, projects are authorized to develop testbed networks and collaborative technology (1) to enable health and human service providers to work together in delivering coordinated care for at-risk populations, (2) to enable health care providers to obtain on-line access to health promotion and disease prevention recommendations from Public Health Service agencies, and (3) to guide and assist clinicians in providing treatment and advice to patients and to facilitate gathering population data sets on the efficacy of treatments and on national health trends.

A five-year authorization is provided for HHS: $24 million for FY 1994, $70 million for FY 1995, $82 million for FY 1996, $94 million for FY 1997, and $94 million for FY 1998.

Section 310. Applications for Libraries.

The plan is required to specify projects that will allow for development of digital libraries of electronic information. Specific projects authorized include development of ways to accurately digitize, organize and store large quantities of electronic information; development of software for searching and manipulating such digital libraries; and development of user-friendly technologies, and associated training of users, for use of networked digital libraries.

Prototype digital libraries, providing public access via the Internet, are to be developed to serve as testbeds for the concepts and methods authorized under this section. These prototypes are to serve as assessment tools in the utility and value of digital libraries and of the technologies available for using them. Finally, NASA is required to develop databases of software and remote-sensing images to be made available via the Internet.

A five-year authorization is provided for NSF: $10 million for FY 1994, $30 million for FY 1995, $35 million for FY 1996, $44 million for FY 1997, and $44 million for FY 1998. A five-year authorization is provided for NASA: $6 million for FY 1994, $16 million for FY 1995, $20 million for FY 1996, $20 million for FY 1997, and $20 million for FY 1998.

Section 311. Applications for Government Information.

The plan is required to specify applications to provide improved public access to information generated by federal, state and local governments. Projects are authorized to connect depository libraries and other sources of government information to the Internet and to demonstrate technologies to facilitate use of government information to support research and education, economic development, and an informed citizenry. A specific requirement is included to establish an inventory/locator system for federal information accessible via the Internet.

A five-year authorization is provided: $8 million for FY 1994, $24 million for FY 1995, $26 million for FY 1996, $30 million for FY 1997, and $30 million for FY 1998.

Section 4. High-Performance Computing and Applications Advisory Committee.

The bill amends subsection 101(b) of the HPC Act of 1991, which establishes an advisory committee for the HPC Program. The amendment broadens the scope of the advisory committee to encompass the applications activities authorized by the new Title III. The membership of the committee is expanded to include representation from the K-12 education community and from consumer and public interest groups.

Section 5. National Research and Education Network Amendments.

Amendments are made to section 102 of the HPC Act of 1991, which establishes the National Research and Education Network (NREN) in order to define a revised NREN Program having three components: (1) research and development of networking software and hardware required for achieving gigabit data transmission rates, (2) experimental test bed networks to develop and demonstrate advanced networking technologies and to support applications requiring levels of network performance not available from privately operated commercial networks (uses for services available from commercial networks are banned 18 months after enactment), and (3) provision of support for researchers, educators and students to obtain access to and use of the Internet for purposes consistent with the Act. Reports to Congress are required which specify a plan for achieving the goals of component (3) defined above, and which describe annual progress toward implementation of the plan.

Section 6. Access to Scientific and Technical Information.

The National Science and Technology Policy, Organization, and Priorities Act of 1976 is amended by (1) adding an additional, presidentially appointed Associate Director for OSTP to oversee federal efforts to disseminate scientific and technical information and (2) adding to the functions of the OSTP Director the task of assisting the President in disseminating scientific and technical information.

Section 7. Conforming Amendments.

AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 1757

OFFERED BY MR. BOUCHER

Strike all after the enacting clause and insert in lieu thereof the following:

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Information Infrastructure Act of 1993".

SEC. 2. FINDINGS.

The Congress finds that—

(1) high-performance computing and high-speed networks have proven to be powerful tools for improving America's national security, industrial competitiveness, research capabilities, and ability to make a wide array of information available for a variety of applications;

(2) Federal programs, such as the High-Performance Computing Program and National Research and Education Network established by Congress in 1991, are vital to the maintenance of United States leadership in high-performance computing and high-speed network development, particularly in the defense and research sectors;

(3) high-performance computing and high-speed networking have the potential to expand dramati-

cally access to information in many fields, including education, libraries, government information dissemination, and health care, if adequate resources are devoted to the research and development activities needed to do so;

(4) high-performance computing and high-speed networking have the potential to expand opportunities for participation for Americans who have disabilities and to improve equality of opportunity, full participation, independent living, and economic self-sufficiency for Americans with disabilities;

(5) the Federal Government should ensure that the applications achieved through research and development efforts such as the High-Performance Computing Program directly benefit all Americans;

(6) the Federal Government should stimulate the development of computing and networking applications and support wider access to network resources so that the benefits of applications so developed can reach the intended users throughout the Nation, including users with disabilities; and

(7) a coordinated, interagency undertaking is needed to identify and promote applications of computing and networking advances developed by the High-Performance Computing Program which will

provide large economic and social benefits to the Nation, including new tools for teaching, the creation of digital libraries of electronic information, the development of standards and protocols to make the stores of government information readily accessible by electronic means, and computer systems to improve the delivery of health care.

SEC. 3. APPLICATIONS OF THE HIGH-PERFORMANCE COMPUTING PROGRAM.

The High-Performance Computing Act of 1991 is amended by adding at the end the following new title:

"TITLE III—APPLICATIONS OF COMPUTING AND NETWORKING

"SEC. 301. ESTABLISHMENT OF APPLICATIONS PROGRAM.

"(a) ESTABLISHMENT.—The Director, through the Federal Coordinating Council for Science, Engineering, and Technology, shall, in accordance with this title—

"(1) establish a coordinated interagency applications program to develop applications of computing and networking advances achieved under the Program described in section 101, that are designed to be accessible and usable by all persons in the United States, including historically underserved populations and individuals with disabilities, in the fields of education, libraries, health care, the provision of government information, and other appropriate fields; and

"(2) develop a Plan for Computing and Networking Applications (hereafter in this title referred to as the 'Plan') describing the goals and proposed activities of the applications program established under paragraph (1), taking into consideration the recommendations of the advisory committee on high-performance computing and applications established under section 101(b).

The President shall designate the Federal agencies and departments which shall participate in the applications program established under paragraph (1). The applications program may be administered as part of the Program established under section 101.

"(b) COLLABORATION WITH NON-FEDERAL ENTITIES.—To the maximum extent possible, the applications program shall involve cost sharing and partnerships among participating Federal departments and agencies, State and local governments, and private sector entities.

"(c) INTEROPERABLE INFORMATION SYSTEMS.— In selecting projects for support under this title, special consideration shall be given to projects which will promote development of interconnected and interoperable information systems.

"SEC. 302. PLAN FOR COMPUTING AND NETWORKING APPLICATIONS.

"(a) REQUIREMENT.—The Plan shall contain a statement of steps which should be taken to implement the applications program established under section 301(a)(1) for the fiscal year in which the Plan is submitted and the succeeding four fiscal years, and shall be submitted to the Congress within one year after the date of enactment of this title. The Plan shall be revised and resubmitted to the Congress at least once each two years thereafter.

"(b) CONTENTS.—The Plan shall—

"(1) establish the goals and priorities for the applications program established under section 301(a)(1), consistent with this Act;

"(2) set forth the specific responsibilities of each Federal agency and department participating in the applications program established under section 301(a)(1) to achieve the goals and priorities established under paragraph (1) of this subsection; and

"(3) describe the recommended levels of Federal funding required for each agency and department to carry out the specific responsibilities set forth in paragraph (2) of this subsection.

"(c) PROGRESS IN IMPLEMENTING PLAN.—(1) Accompanying the initial submission of the Plan shall be—

"(A) a summary of the achievements of Federal efforts during the preceding fiscal year to develop computing and networking applications and to advance the technologies on which the applications depend; and

"(B) any recommendations regarding additional action or legislation which may be required to assist in implementing the Plan.

"(2) Accompanying each subsequent submission of the Plan shall be—

"(A) a summary of the achievements of Federal efforts since the previous submission of the Plan to develop computing and networking applications and to advance the technologies on which the applications depend, including an estimate of the number and the demographic diversity of users served in each application;

"(B) an evaluation of the progress made toward achieving the goals and priorities established under subsection (b)(1);

"(C) a summary of problems encountered in implementing the Plan; and

"(D) any recommendations regarding additional action or legislation which may be required to assist in implementing the Plan.

"SEC. 303. RESPONSIBILITIES OF THE FEDERAL COORDINATING COUNCIL FOR SCIENCE, ENGINEERING, AND TECHNOLOGY.

"The Federal Coordinating Council for Science, Engineering, and Technology shall—

"(1) develop the Plan as provided in section 301(a)(2);

"(2) coordinate the activities of Federal agencies and departments undertaken pursuant to the Plan and report at least annually to the President, through the Chairman of the Council, on any recommended changes in agency or departmental roles that are needed better to implement the Plan; and

"(3) assess, prior to the President's submission to the Congress of the annual budget estimate, each agency and departmental budget estimate for consistency with the Plan and make the results of that assessment available to the appropriate elements of the Executive Office of the President, particularly the Office of Management and Budget.

"SEC. 304. NOTIFICATION REQUIREMENT.

"(a) REQUIREMENT.—Each Federal agency and department designated by the President under section 301(a) as a participant in the applications program shall, as part of its annual request for appropriations to the Office of Management and Budget—

"(1) identify each element of its activities which—

"(A) contributes primarily to the implementation of the Plan; or

"(B) contributes primarily to the achievement of other objectives but aids Plan implementation in important ways; and

"(2) identify the portion of its request for appropriations that is allocated to each such element.

"(b) OFFICE OF MANAGEMENT AND BUDGET REVIEW.—The Office of Management and Budget shall review each submission received under this section in light of the goals, priorities, and agency and departmental responsibilities set forth in the Plan. The President's annual budget request shall include a statement of the portion of each appropriate agency or department's annual budget request that is allocated to efforts to achieve the goals and priorities established under section 302(b)(1).

"SEC. 305. NETWORK ACCESS.

"(a) CONNECTIONS PROGRAM.—The Plan shall include programs administered by the National Science Foundation and the National Telecommunications and Information Administration to—

"(1) foster the development of network services in local communities which will connect institutions of education at all levels, libraries, museums, and State and local governments to each other; and

"(2) provide funds for the purchase of network services to entities described in paragraph (1), or organizations representing such entities, to connect to the Internet.

Such program shall include funding for the acquisition of required hardware and software and for the establishment of broadband connections to the Internet. Not more than 75 percent of the cost of any project for which an award is made under this subsection shall be provided under this Act.

"(b) TRAINING.—The Plan shall include programs administered by the National Science Foundation, the National Telecommunications and Information Administration, and other appropriate agencies and departments to train teachers, students, librarians, and State and local government personnel in the use of computer networks and the Internet. Training programs for librarians shall be designed to provide skills and training materials needed by librarians to instruct the public in the use of hardware and software for accessing and using computer networks and the Internet. Training programs shall include programs designed for individuals with disabilities.

"(c) REPORT.—The Director shall, within one year after the date of enactment of this title, submit a report to Congress which shall include—

"(1) findings of an examination of the extent to which the education and library communities and State and local government have access to the Internet, including the numbers and the geographic distribution, by type, of institutions having access, and including the numbers of institutions having human/computer interfaces suitable for use by individuals with disabilities;

"(2) a statement of the extent to which broadband connections to the Internet exist for the education and library communities and State and local governments, including the numbers and the geographic distribution, by type, of institutions having access;

"(3) an assessment of the factors limiting access by institutions of education at all levels, libraries, and State and local governments to the Internet and an estimate of the cost of providing universal broadband access for those institutions to the Internet; and

"(4) recommendations for collaborative programs among Federal, State, and local governments and the private sector to expand connectivity to the Internet for educational institutions, libraries, and State and local governments.

"(d) AUTHORIZATION OF APPROPRIATIONS.—(1) There are authorized to be appropriated to the National Science Foundation for the purposes of this section, $15,000,000 for fiscal year 1994, $30,000,000 for fiscal year 1995, and $50,000,000 for fiscal year 1996.

(2) There are authorized to be appropriated to the National Telecommunications and Information Administration for the purposes of this section, $54,000,000 for fiscal year 1994, $150,000,000 for fiscal year 1995, and $150,000,000 for fiscal year 1996.

"SEC. 306. RESEARCH IN SUPPORT OF APPLICATIONS.

"(a) IN GENERAL.—The Plan shall specify the basic and applied research and human resource development activities in areas, such as computer science and engineering, mathematics, computer visualization, and human cognition, that will provide the foundation for achieving the applications included in the Plan. The Plan shall include basic and applied research activities related to the long-range social and ethical implications of applications of high-speed networking and high-performance computing. The Plan shall specify those activities included in the Program under title I which contribute to the development of applications included in the Plan.

"(b) NETWORK SECURITY AND PRIVACY.—The Plan shall specify research programs needed to create means to—

"(1) ensure the security and privacy of transmissions over the Internet and the integrity of digital information accessed via the Internet; and

"(2) facilitate the management and protection of copyrighted information which is accessed via the Internet.

"(c) EASE OF INTERNET USE.—The Plan shall specify research programs needed to develop and demonstrate human/computer interfaces that will simplify access to and use of the Internet by nonspecialists in computing and networking technologies and by individuals with disabilities.

"(d) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated for the purposes of this section, $6,000,000 for fiscal year 1994, $15,000,000 for fiscal year 1995, $20,000,000 for fiscal year 1996, $20,000,000 for fiscal year 1997, and $20,000,000 for fiscal year 1998.

"SEC. 307. APPLICATIONS FOR EDUCATION.

"(a) IN GENERAL.—The Plan shall specify projects to develop and apply computing and networking technologies for use in education at all levels from early childhood education through higher education, including projects for the education and training of individuals with disabilities. The National Science Foundation shall be the lead agency for implementing the activities required by this section, and shall consult with the Department of Education in implementing those activities. Activities under this section shall include—

"(1) projects, including support for acquisition of required computer hardware and software, that demonstrate the educational value of the Internet, including cost effectiveness, in providing for advances in distance learning and electronic classrooms, facilitating nationwide communication among educators and students, access to databases of information in digital format, and access to innovative curricular materials;

"(2) development, testing, and evaluation of computer systems, computer software, and computer networks for—

"(A) teacher training, including teachers in special education programs; and

"(B) informal education outside of school, including workforce training in mathematics, science, and technology and in specific job-related skills, including literacy; and

"(3) development, testing, and evaluation of advanced educational software and of network-based information resources.

"(b) ELEMENTARY AND SECONDARY EDUCATION.—In accordance with subsection (a), applications for elementary, secondary, and vocational/technical education shall be designed to complement and strengthen ongoing national, State, and local educational restructuring and reform activities and shall include—

"(1) projects in computing and networking that—

"(A) provide for network connections among elementary and secondary schools in local regions and connections to the Internet to enable students and teachers to—

"(i) communicate with their peers;

"(ii) communicate with educators and students in institutions of higher education; and

"(iii) access educational materials and other computing resources;

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"(B) address the needs of rural populations and of urban communities; and

"(C) address the needs of individuals with disabilities;

"(2) collection and dissemination of information about ongoing elementary and secondary educational projects, including special education projects, based on application of computing and networking technologies, and about other educational resources available over the Internet;

"(3) development and evaluation of undergraduate courses in the educational applications of computing and networking for the instruction of students preparing for teaching careers, including courses that will ensure the early familiarization and training of these students in the use of the Internet; and

"(4) development, testing, and evaluation of educational software designed for collaborative use over the Internet, including tools that will enable classroom teachers easily to adapt software to local conditions.

"(c) COOPERATION.—In carrying out the requirements of this section, the National Science Foundation, the Department of Education, and other Federal agencies participating in such activities shall work with the computer hardware, computer software, and communications industries, authors and publishers of educational materials, State education departments, and local school districts, as appropriate.

"(d) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the National Science Foundation for the purposes of this section, $16,000,000 for fiscal year 1994, $45,000,000 for fiscal year 1995, $60,000,000 for fiscal year 1996, $75,000,000 for fiscal year 1997, and $75,000,000 for fiscal year 1998.

"SEC. 306. APPLICATIONS FOR HEALTH CARE.

"(a) IN GENERAL.—The Plan shall specify projects to develop and apply high-performance computing and high-speed networking technologies for use in the health care sector. The Department of Health and Human Services, through the National Institutes of Health and the Centers for Disease Control and Prevention, shall be the lead agency for implementing the activities required by this section.

"(b) CLINICAL INFORMATION SYSTEMS.—In accordance with subsection (a), applications related to clinical information systems shall include—

"(1) testbed networks for linking hospitals, clinics, doctor's offices, medical schools, medical libraries, and universities to enable health care providers and researchers to share medical images and to develop computer-based records;

"(2) software and visualization technology for visualizing the human anatomy and analyzing diagnostic images and records;

"(3) virtual reality technology for simulating surgical and medical procedures;

"(4) collaborative technology to allow several health care providers in remote locations to provide real-time treatment to patients;

"(5) interactive technologies to allow health care providers to monitor, evaluate, and treat patients in nonclinical settings;

"(6) database technology to provide health care providers with access to relevant medical information and literature;

"(7) database technology for storing, accessing and transmitting patients' medical records while protecting the accuracy and privacy of those records;

"(8) numerical simulation of chemical interactions relevant to reducing the time and cost of drug development;

"(9) three dimensional geometric modeling and artificial intelligence methods for interpreting an array of medical images; and

"(10) complex simulations of sociological populations affected disproportionately by selected diseases or disorders.

"(c) HEALTH INFORMATION TO THE PUBLIC.—In accordance with subsection (a), applications related to delivery of health information to the public shall include—

"(1) development, testing, and evaluation of database and network technologies for the storage of consumer-oriented, interactive, multimedia materials for health promotion, and for the distribution of such materials to public access points, such as community health and human service agencies, Centers for Independent Living established by the Rehabilitation Act of 1973, organizations established by title I of the Technology-Related Assistance for Individuals with Disabilities Act of 1988, schools, and public libraries;

"(2) pilot programs to develop, test, and evaluate the effectiveness and cost efficiency of interactive, multimedia materials to assist patients in deciding among health care options;

"(3) development and demonstration of human/computer interfaces to allow nonspecialists in computing and networking technologies ease of access to and use of databases of health information and networks providing health information service; and

"(4) development, testing, and evaluation of database and network access technologies to provide individuals with health information, including health risk appraisal, preventative medical advice, and disease treatment options, which is oriented to nonhealth professionals and which is customized to take into consideration an individual's medical history.

"(d) HEALTH DELIVERY SYSTEMS AND POPULATION DATA SETS.—In accordance with subsection (a), applications for health delivery systems and for gathering population data sets shall include—

"(1) testbed networks and software that permits collaborative communication among local public and private health and human service providers, such as health centers, clinics, entitlement offices, and school-based clinics, to enable health and human service providers to work together in delivering coordinated services for at-risk populations;

"(2) pilot programs to develop high speed communications networks and software for providing health care providers with—

"(A) immediate, on-line access to up-to-date clinic-based health promotion and disease prevention recommendations from the Centers for Disease Control and other Public Health Service agencies; and

"(B) a two-way communications link with prevention specialists in State and local health departments, and other agencies with information germane to clinic-based health promotion and disease prevention; and

"(3) development, testing, and evaluation of database technologies to provide clinicians with access to information to guide and assist them in providing diagnosis, providing treatment, and providing advice regarding health promotion and disease prevention to patients, and to facilitate the gathering of systematic population data sets in compatible formats on the efficacy of treatments and on national health trends.

"(e) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to the Secretary of Health and Human Services for the purposes of this section, $22,000,000 for fiscal year 1994, $54,000,000 for fiscal year 1995, $72,000,000 for fiscal year 1996, $90,000,000 for fiscal year 1997, and $90,000,000 for fiscal year 1998.

"SEC. 309. APPLICATIONS FOR LIBRARIES.

"(a) IN GENERAL.—The Plan shall specify projects to develop technologies for 'digital libraries' of electronic information. The National Science Foundation shall be the lead agency for implementing the activities required by this section, and in implementing this section shall take into account the needs of individuals with disabilities.

"(b) DIGITAL LIBRARIES.—In accordance with subsection (a), activities to support the development of digital libraries shall include—

"(1) development of advanced data storage systems capable of storing hundreds of trillions of bits of data and giving thousands of users simultaneous and nearly instantaneous access to that information;

"(2) development of high-speed, highly accurate systems for converting printed text, page images, graphics, and photographic images into electronic form;

"(3) development of database software capable of quickly searching, filtering, and summarizing large volumes of text, imagery, data, and sound;

"(4) encouragement of the development and adoption of common standards and, where appropriate, common formats for electronic data;

"(5) development of computer-based means to categorize and organize electronic information in a variety of formats;

"(6) training of database users and librarians in the use of and development of electronic databases;

"(7) development of means for simplifying the utilization of networked databases distributed around the Nation and around the world;

"(8) development of visualization methods for quickly browsing large volumes of imagery; and

"(9) development of means for protecting copyrighted material in electronic form.

"(c) DEVELOPMENT OF PROTOTYPES.—In accordance with subsection (a), the Plan shall provide for the development of prototype digital libraries to serve as testbeds for the systems, software, standards, and methods developed under subsection (b). The development of prototype digital libraries may involve nonprofit, private institutions that collect and maintain specimens, materials, or other items used in research, such as natural history museums. The prototype digital libraries shall be accessible by the public via the Internet. In carrying out this subsection, an evaluation shall be conducted of the suitability and utility of distributing electronic information over the Internet, including cataloging and evaluating the kinds of uses and determining barriers that impair use of the Internet for this purpose.

"(d) DEVELOPMENT OF DATABASES OF REMOTE-SENSING IMAGES.—The National Aeronautics and Space Administration shall develop databases of software and remote-sensing images to be made available over computer networks.

"(e) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated—

"(1) to the National Science Foundation for the purposes of this section, $8,000,000 for fiscal year 1994, $16,000,000 for fiscal year 1995, $22,000,000 for fiscal year 1996, $32,000,000 for fiscal year 1997, and $32,000,000 for fiscal year 1998; and

"(2) to the National Aeronautics and Space Administration for the purposes of this section, $4,000,000 for fiscal year 1994, $8,000,000 for fiscal year 1995, $10,000,000 for fiscal year 1996, $12,000,000 for fiscal year 1997, and $12,000,000 for fiscal year 1998.

"SEC. 310. APPLICATIONS FOR GOVERNMENT INFORMATION.

"(a) IN GENERAL.—The Plan shall specify projects needed to develop and apply high-performance computing and high-speed networking technologies to provide improved public access to information generated by Federal, State, and local governments, including access by individuals with disabilities.

"(b) LEAD AGENCY.—The President shall designate a lead agency for implementing the activities required by this section. The lead agency shall issue policy guidelines designed to foster—

(1) a diversity of public and private sources for, and a competitive marketplace in, information products and services based on government information; and

(2) dissemination of government information to the public on a timely, equitable, and affordable basis and in a manner that will promote the usefulness of the information to the public.

"(c) PROJECTS.—In accordance with subsection (a), projects shall be undertaken which—

"(1) connect depository libraries and other sources of government information to the Internet to enable—

"(A) access to Federal Government information and databases in electronic formats;

"(B) access to State or local government information;

"(C) access to related resources which enhance the use of government information, including databases available through State projects funded pursuant to the Technology-Related Assistance for Individuals with Disabilities Act of 1988; and

"(D) linkages with other libraries and institutions to enhance use of government information; and

"(2) demonstrate, test, and evaluate technologies to increase access to and to facilitate effective use of government information and databases for support of research and education, economic development, and an informed citizenry.

"(d) FEDERAL INFORMATION LOCATOR.—In accordance with subsection (a), an information locator system shall be established which is accessible by the public via the Internet and which provides citations to Federal information and guidance on how to obtain such information.

"(e) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated for the purposes of this section, $4,000,000 for fiscal year 1994, $12,000,000 for fiscal year 1995, $16,000,000 for fiscal year 1996, $21,000,000 for fiscal year 1997, and $21,000,000 for fiscal year 1998.".

SEC. 4. HIGH-PERFORMANCE COMPUTING AND APPLICATIONS ADVISORY COMMITTEE.

Section 101(b) of the High-Performance Computing Act of 1991 is amended to read as follows:

"(b) HIGH-PERFORMANCE COMPUTING AND APPLICATIONS ADVISORY COMMITTEE.—(1) The Director shall establish an advisory committee on high-performance computing and applications consisting of non-Federal members, including representatives of the research and library communities, education at all levels, consumer and public interest groups, network providers, and the computer, telecommunications, and information industries, who are specially qualified to provide the Director with advice and information on high-performance computing and on applications of computing and networking. The recommendations of the advisory committee shall be considered in reviewing and revising the Program described in this section and the Plan required by section 301(a)(2). The advisory committee shall provide the Director with an independent assessment of—

"(A) progress in implementing the Program described in this section and the Plan required by section 301(a)(2);

"(B) the need to revise the Program described in this section and the Plan required by section 301(a)(2);

"(C) the balance between the components of the activities undertaken pursuant to this Act;

"(D) whether the research, development and demonstration projects undertaken pursuant to this Act are—

"(i) helping to maintain United States leadership in computing and networking technologies and in the application of those technologies; and

"(ii) promoting competitive private sector markets in the provision of products and services related to these technologies and their applications;

"(E) whether the applications developed under title III are successfully addressing the needs of the targeted populations, including assessment of the number of users served by those applications; and

"(F) other issues identified by the Director.

"(2) The advisory committee established under paragraph (1) shall meet not less than once annually, following notice in the Federal Register, for the purpose of receiving oral and written public testimony on the subjects identified in subparagraphs (A) through (F) of paragraph (1). The advisory committee shall compile and submit an annual report to the Director and to the Congress containing the findings and recommendations required under this subsection and summarizing the public testimony received. In addition, the advisory committee may meet periodically as determined by its members.

"(3) The Director shall provide such support as is required to allow the advisory committee established under paragraph (1) to meet and to carry out the responsibilities assigned by this subsection.".

SEC. 5. NATIONAL RESEARCH AND EDUCATION NETWORK AMENDMENTS.

Section 102 of the High-Performance Computing Act of 1991 is amended to read as follows:

"SEC. 102. NATIONAL RESEARCH AND EDUCATION NETWORK PROGRAM.

"(a) ESTABLISHMENT.—As part of the Program described in section 101, the National Science Foundation, the Department of Defense, the Department of Energy, the Department of Commerce, the National Aeronautics and Space Administ ation, the Department of Education, and other agencies p rticipating in the Program shall support the establishme t of the National Research and Education Network Pr gram. The Network Program shall consist of the followi g components:

"(1) Rese ch and development of networking software and h dware required for developing high-performance d a networking capabilities with the goal of achievin the transmission of data at a speed of one gigabit p r second or greater.

"(2) Fed l experimental test bed networks for—

"(A) leveloping and demonstrating advanced ne orking technologies resulting from the activit s described in paragraph (1), including any re sonably necessary assessment of the reliability f such technologies under realistic operating nditions; and

"(B) roviding connections and associated network s vices for purposes consistent with this Act v ich require levels of network capabilities not ommercially available.

"(3) Prov on of support for researchers, educators, and stu ents to obtain access to and use of the Internet t llow for communication with other individuals in the research and education communities and to allow for access to high-performance computing systems, electronic information resources, other research facilities, and libraries.

"(b) TEST BED NETWORK CHARACTERISTICS.—The test bed networks shall—

"(1) be developed and deployed in coordination with the computer hardware, computer software, telecommunications, and information industries;

"(2) be designed, developed, and operated in collaboration with potential users in government, industry, and research institutions and educational institutions;

"(3) be designed, developed, and operated in a manner which fosters and maintains competition and private sector investment in high-speed data networking within the telecommunications industry;

"(4) be designed and operated in a manner which promotes and encourages research and development leading to the creation of commercial data transmission standards, enabling the establishment of privately developed high-speed commercial networks;

"(5) be designed and operated so as to ensure the application of laws that provide network and information resources security, including those that protect copyright and other intellectual property rights, and those that control access to data bases and protect national security;

"(6) have accounting mechanisms which allow users or groups of users to be charged for their usage of copyrighted materials available over the test bed networks and, where appropriate and technically feasible, for their usage of the test bed networks; and

"(7) be interoperable with Federal and non-Federal computer networks, to the extent appropriate, in a way that allows autonomy for each component network.

"(c) NETWORK ACCESS.—The Federal agencies and departments participating in activities under this section shall develop a plan with specific goals for implementing the requirements of subsection (a)(3), including provision for financial assistance to educational institutions, public libraries, and other appropriate entities. This plan shall be submitted to the Congress not later than one year after the date of enactment of the National Information Infrastructure Act of 1993. Each year thereafter, the Director shall report to Congress on progress in implementing subsection (a)(3).

"(d) RESTRICTION ON USE OF TEST BED NETWORKS.—(1) The Federal test bed networks shall not be used to provide network services that are not related to the activities under paragraphs (1) and (2) of subsection (a) and that could otherwise be provided satisfactorily using commercially available network services. Determination of satisfactory availability shall include consideration of geographic access to and affordability of service, and timeliness and technical performance standards in providing services.

"(2) The requirements of paragraph (1) shall take effect on the date set forth in the report required under paragraph (3).

"(3) Six months following the date of enactment of the National Information Infrastructure Act of 1993, the Director, after consultation with the Federal agencies and departments supporting Federal test bed networks, shall provide a report to Congress which—

"(A) describes the technical developments necessary to allow implementation of paragraph (1);

"(B) determines the earliest feasible date for implementing paragraph (1); and

"(C) sets forth that date as the date on which paragraph (1) shall take effect.

Should the Director subsequently determine that, for technical reasons, the requirements of paragraph (1) can not be imposed on that date, the Director shall, not less than 3 months prior to that date, report to Congress on the reasons for the delay in imposing the requirements of paragraph (1), and shall set forth a new date on which paragraph (1) shall take effect.

"(e) ADVANCED RESEARCH PROJECTS AGENCY RESPONSIBILITY.—As part of the Program, the Department of Defense, through the Advanced Research Projects Agency, shall support research and development of advanced fiber optics technology, switches, and protocols needed to develop the Network Program.

"(f) INFORMATION SERVICES.—The Director shall assist the President in coordinating the activities of appropriate agencies and departments to promote the development of information services that could be provided over the Internet consistent with the purposes of this Act. These services may include the provision of directories of the users and services on computer networks, data bases of unclassified Federal scientific data, training of users of data bases and computer networks, and technology to support computer-based collaboration that allows researchers and educators around the Nation to share information and instrumentation.

"(g) USE OF GRANT FUNDS.—All Federal agencies and departments are authorized to allow recipients of Federal research grants to use grant moneys to pay for computer networking expenses.

"(h) LIMITATION ON USE OF FUNDS.—Development of data communications networks pursuant to this Act shall be through purchase of standard commercial transmission and network services from vendors whenever feasible, and by contracting for customized services when such purchase is not feasible, in order to minimize Federal investment in network hardware and software.".

SEC. 6. CONFORMING AMENDMENTS.

The High Performance Computing Act of 1991 is amended—

(1) in section 3(1)—

(A) by amending subparagraph (A) to read as follows:

"(A) accelerate progress toward a universally accessible high-capacity and high-speed data network for the Nation;"; and

(B) by striking "Network" and inserting in lieu thereof "Internet" in subparagraph (C);

(2) in section 4—

(A) by redesignating paragraphs (1), (2), (3), (4), and (5) as paragraphs (2), (7), (8), (10), and (11), respectively;

(B) by inserting before paragraph (2), as so redesignated by subparagraph (A) of this paragraph, the following new paragraph:

"(1) 'broadband' means a transmission rate for digital information on a communications network which exceeds the maximum rate possible for transmission of digital information on normal copper telephone wires;";

(C) by inserting after paragraph (2), as so redesignated by subparagraph (A) of this paragraph, the following new paragraphs:

"(3) 'disabilities' means functional limitations of hearing, vision, movement, manipulation, speech, and interpretation of information;

"(4) 'educational institutions' includes institutions of early childhood education, elementary and secondary education, postsecondary education, and vocational/technical education;

"(5) 'education at all levels' includes early childhood education, elementary and secondary education, postsecondary education, and vocational/technical education;

"(6) 'Federal test bed networks' means the Federal experimental test bed networks described in section 102(a)(2);";

(D) by inserting after paragraph (8), as so redesignated by subparagraph (A) of this paragraph, the following new paragraph:

"(9) 'Internet' means the network of both Federal and non-Federal interoperable packet switched data networks;"; and

(E) by amending paragraph (10), as so redesignated by subparagraph (A) of this paragraph, to read as follows:

"(10) 'Network Program' means the National Research and Education Network Program established under section 102; and";

(3) in section 101(a)(2)(A) and (B), by striking "Network" and inserting in lieu thereof "Federal test bed networks";

(4) in section 101(a)(2)(C), by inserting "the private sector, States, and" after "computer networks of";

(5) in section 101(a)(4)(C), by striking "establishment of the Network" and inserting in lieu thereof "Network Program";

(6) in section 201(a)(2), by striking "Network" both places it appears and inserting in lieu thereof "Internet";

(7) in section 201(a)(3), by striking "Network" and inserting in lieu thereof "Internet for the purposes of this Act"; and

(8) in section 201(a)(4), by inserting "consistent with section 102," before "assist regional networks".

Mr. BOUCHER. H.R. 1757 will capture fully the promise of high performance computing and high speed networking first established in the High Performance Computing Act of 1991. The bill conforms to the information infrastructure provisions of the President's technology plan announced in February of this year.

The purpose of the legislation is to provide the research and development underpinnings necessary for the achievement of National Information Superhighways capable of delivering voice, video, and data at gigabit speeds to every home and office in the Nation. Programs are authorized to make new networking technology widely available to the public for such applications as routing medical information at unprecedented speeds, developing digital libraries of information that can be accessed from any point on the network, linking schools and teachers for distance learning, and disseminating the vast stores of government information.

The bill will foster the creation of a common set of standards and protocols for use of the high speed network and will finance the development and demonstration of new networking technologies.

I was pleased to introduce H.R. 1757 on April 22 and to be joined in co-sponsorship of the measure by the ranking Republican member of this subcommittee, Mr. Boehlert, and by subcommittee members Tim Valentine, James Barcia, and Anna Eshoo, and Eddie-Bernice Johnson. I also want to recognize the efforts of each of these members, and particularly the efforts of Mr. Boehlert, in developing and refining this measure for today's markup.

The subcommittee has held three days of hearings on the bill to obtain the views of the administration; individuals from the telecommunications, computer, software, information, and network provider industries; users of network services from the research and education communities; and individuals representing the health sciences and libraries. These witnesses expressed strong support for the goals and the focus of the legislation and provided constructive recommendations for modification, many of which appear in the subcommittee amendment in the nature of a substitute which will be considered this morning.

In particular, the substitute includes new requirements for development of the means of ensuring the integrity of information that is transmitted over the network. It also contains a provision directing the use of commercially available network services whenever that is feasible, and it clarifies the conditions under which use of the Federal test bed network will be restricted, and institutes a process rather than a fixed period of time in specifying the implementation of that restriction. The substitute incorporates a number of recommendations made by the administration, simplifying reporting requirements and deleting provisions which assign specific responsibilities to the OSTP staff.

The authorization for the connections program is reduced from 5 to 3 years, also in conformance with administration recommendations, and that change will reduce the total authorization level from $1.55 billion to $1.36 billion over the 5-year period. A chart that shows the authorization levels in the substitute by program area is also included in the explanation that is before the members.

We have conducted a series of discussions with the Committee on Education and Labor to develop language in the substitute that requires consultation between the National Science Foundation and the Department of Education on implementation of the provisions in the bill dealing with education applications and clarifying that the applications supported under the bill should benefit and be accessible to individuals with disabilities, and that educational applications should include applications for education at all levels. As a result of these modifications, the Education Committee will not be requesting a sequential referral of the bill.

The legislation in the form of the substitute before the subcommittee today is supported by a very large number of industries and individual companies and by virtually every aspect of the research and education community, and a list of supporting organizations, both in the private and public sectors, has been placed before each member, and I would encourage members to review that list.

The Information Infrastructure Act of 1993 encompasses research, development, and demonstration of computing and networking technologies which are essential activities to achieve in this Nation the world's most capable interactive communications network.

I'm pleased to commend the amendment in the nature of a substitute to the subcommittee for its concurrence, and to recognize at this time the gentleman from New York.

Mr. **BOEHLERT**. Thank you very much, Mr. Chairman.

Of all the activities we're engaged in collectively, this is one of the most exciting. We're talking about 21st century stuff here. The 21st century is only 79 months away. So it's not all that far. But this is something we have worked on for a number of years and our former colleague, who is now the Vice President of the United States, Albert Gore, we've worked with him on it. I'm excited about it. The prospects for what this offers for America and for the world is limited only by one's imagination.

So let's get on with the markup and get this to the full committee and the floor and enacted into law as soon as possible. We will all be the better for it.

Thank you.

[The statement of Mr. Boehlert follows:]

PREPARED STATEMENT OF SHERWOOD BOEHLERT

Mr. Chairman, the subject of this bill, the information superhighway is crucial to the economic health of this nation—the rapid growth in information technologies will fuel the economic expansion of this nation well into the 21st century—just as the development of railways and roads fueled the expansion of the nation during this century.

We recognized the importance of the information technology industry when we passed the high performance computing act 2 years ago. This legislation will expand on the foundation set by that law—by improving the dissemination of information between Government agencies, schools, hospitals and libraries—thereby allowing almost any citizen easy access to information within minutes, and at the touch of a button.

Mr. Chairman, I applaud the goals of this legislation and want to acknowledge your leadership in developing rational legislation to deal with a very complex problem.

Mr. **BOUCHER**. Are other members of the subcommittee seeking recognition for the purposes of an opening statement? The gentleman from Pennsylvania.

Mr. **WALKER**. Thank you, Mr. Chairman.

Mr. Chairman, I know you have worked very hard with industry, educators, and government agencies to craft this bill, and I congratulate you for the work that has been done. One of my biggest concerns in building the new computer highway was—it probably won't come as a surprise to anybody—the cost and where would the $1.39 billion come from. Whether it's building concrete bridges or fiber optic bridges, we must get out of the fast lane of driving this country deeper into debt.

But I understand, Mr. Chairman, that you are going to offer an amendment to have this money authorized out of existing authorizations, and let me say, first of all, I appreciate that. And I will support that particular amendment. I think that takes us a long way toward assuring that we have the right kind of way of approaching this problem.

I do want to point out that suggesting that spending in this area be increased by 59 percent in fiscal year 1994 alone is going to get us into a kind of tight budgetary situation. In fiscal year 1993, high performance computing efforts were appropriated $772 million. This bill, along with other proposed programs for fiscal year 1994, would authorize a total of $1.225 billion over—that's over $450 million in new spending. And so we are going to have some real competition for some of this money, but I think by operating within existing authorization programs it does move us substantially in the right direction.

There are some other additional issues, Mr. Chairman, that need to be addressed before our full committee markup. I understand staff is working on finding acceptable language. An let me point out the kind of thing I'm concerned about. As was expressed in some private conversations that we've had about this bill, I have concerns that we not replace private investment money with public money in this program, that we make certain that whatever was going to be invested in the private sector goes forward and is invested and is not replaced as a result of this program with public monies.

And I think there are some ways of approaching that by assuring, for example, that we do not have companies coming in and using this money for stuff that they would otherwise be able to buy with private investment money. We're seeking some language. Your staff is cooperative, working with us toward finding that language. Hopefully, by the time we get to full committee, we will have some language that will be acceptable to everybody that will allay some of my concerns in that area.

For right now, though, Mr. Chairman, I congratulate you for what you've done. I will have one amendment later on to the bill, but I think we have a very good first step in the subcommittee here.

[The prepared opening statement of Mr. Walker follows:]

HONORABLE BOB WALKER
HR 1757
OPENING STATEMENT

THANK YOU, MR. CHAIRMAN

I KNOW THE CHAIRMAN HAS WORKED VERY HARD WITH INDUSTRY, EDUCATORS, AND GOVERNMENT AGENCIES TO CRAFT THIS BILL.

ONE OF MY BIGGEST CONCERNS IN BUILDING THIS NEW COMPUTER HIGHWAY--
IS, WHERE WOULD THE $1.359 **BILLION** COME FROM.

WHETHER IT IS BUILDING CONCRETE BRIDGES OR FIBER BRIDGES, WE MUST GET OUT OF THE FAST LANE OF DRIVING THIS COUNTRY DEEPER INTO DEBT.

I UNDERSTAND THAT AN AMENDMENT WILL BE OFFERED TO HAVE THIS BILL AUTHORIZED OUT OF EXISTING AUTHORIZATIONS.

I WILL SUPPORT THIS AMENDMENT.

HOWEVER, I MUST POINT OUT THAT I NOT SURE IT IS PRUDENT OF CONGRESS TO BE SUGGESTING THAT SPENDING IN THIS AREA BE INCREASED 59% IN FY 94 ALONE. IN FY 93, HIGH PERFORMANCE COMPUTING EFFORTS WERE APPROPRIATED AT $772 MILLION DOLLARS. THIS BILL, ALONG WITH THE OTHER PROPOSED PROGRAMS FOR FY 94, WOULD AUTHORIZE A TOTAL OF $1.225 BILLION DOLLARS, OVER $450 MILLION OF NEW SPENDING.

MR. CHAIRMAN, I HAVE SOME ADDITIONAL ISSUES THAT NEED TO BE ADDRESSED BEFORE OUR FULL COMMITTEE MARK-UP, AND I UNDERSTAND THE STAFF IS WORKING FIND ACCEPTABLE LANGUAGE.

THANK YOU, MR. CHAIRMAN.

Mr. BOUCHER. Thank you very much, Mr. Walker. And I want to commend you and your staff for your excellent cooperation with us as we have moved this forward and for the excellent work that you have done in cooperation with Mr. Boehlert in assisting us and refining this measure.

The gentleman from Texas, Mr. Johnson.

Mr. JOHNSON of Texas. Thank you, sir. I appreciate that.

I would just like to ask if I could enter my statement, my full statement, in the record, without objection.

Mr. BOUCHER. Without objection, it will be received.

[The prepared opening statement of Mr. Johnson of Texas follows:]

OPENING STATEMENT
CONGRESSMAN SAM JOHNSON
SCIENCE SUBCOMMITTEE
JUNE 17, 1993

THANK YOU MR. CHAIRMAN,

TODAY, WE ARE MARKING UP H.R. 1757 THE "NATIONAL INFORMATION INFRASTRUCTURE ACT OF 1993" A BILL WITH GOOD INTENTIONS BUT BAD IMPLICATIONS.

I AGREE THAT THE GOVERNMENT SHOULD BE INVOLVED IN CREATING A COMMUNICATIONS HIGHWAY BUT ONLY TO THE EXTENT OF PROVIDING GUIDELINES AND STANDARDS, OR IN SIMPLE TERMS, A BLUE PRINT THAT INDUSTRY CAN FOLLOW AND IMPLEMENT. THE GOVERNMENT SHOULD NOT BE COMPETING AND DUPLICATING PROGRAMS THAT EXIST IN THE PRIVATE SECTOR.

I HAVE COUNTED THE WORD "DEVELOP" OVER 20 TIMES IN THIS BILL. I ASK ANYONE TO ANSWER THIS QUESTION: WHAT CAN THE GOVERNMENT "DEVELOP" BETTER THAN

THE PRIVATE SECTOR? FROM PAST EXPERIENCE NOTHING BETTER BUT DEFINITELY SLOWER.

THE REAL QUESTION COMES DOWN TO DOLLARS. THIS BILL AUTHORIZES $1.3 BILLION DOLLARS OVER THE NEXT FIVE YEARS. TO DO WHAT?-- TO DEVELOP INTERFACES, TEST BEDS FOR DIGITAL LIBRARIES, GIGABIT TRANSMISSION, FIBER OPTICS, SWITCHES AND DATA STORAGE SYSTEMS.

IN FACT, LET ME GIVE YOU SOME EXAMPLES OF THE DUPLICATION AND WASTED DOLLARS THAT WILL COME BY AUTHORIZING $1.3 BILLION DOLLARS IN NEW MONEY.

IN REGARD TO SECTION 307 PART 1 OF THE BILL I WOULD LIKE TO MAKE THIS POINT. THE UNIVERSITIES IN TEXAS ARE ALREADY CONNECTED BY INTERNET THROUGH THEnet AND ALL K-12 TEACHERS HAVE ACCESS TO INTERNET THROUGH TENET. YOU WANT TO KNOW THE BEST PART OF THIS PROGRAM, IT WAS COMPLETED WITH OUT FEDERAL FUNDS.

SECOND, AN ARTICLE IN THE WALL STREET JOURNAL ON MONDAY, MAY 7 DISCUSSES A COMPANY CALLED CABLEVISION. THIS COMPANY IS TURNING CABLE T.V. LINES INTO DATA HIGHWAYS FOR COMPUTER NETWORKS. THEIR GOAL, AND I QUOTE, IS TO ALLOW "HOSPITALS, SCHOOLS, STATE AND LOCAL GOVERNMENTS TO MOVE BIG DATA FILES AROUND AND TAKE ADVANTAGE OF THE ALREADY DEPLOYED CABLE NETWORK." THEIR EXAMPLE IS "A RADIOLOGIST COULD SEND A HIGH-QUALITY, X-RAY IMAGE TO A DOCTOR'S OFFICE IN ORDER TO DISCUSS THE ANALYSIS OF A PROBLEM. IF THIS SOUNDS FAMILIAR, LOOK AT SEC. 308 OF THE BILL.

THIRD, MICROSOFT AND TIME WARNER ARE COLLABORATING TO CHAMPION MULTIMEDIA APPLICATIONS. THEIR JOINT VENTURE WILL ESTABLISH COMPATIBLE SOFTWARE AND HARDWARE TO FIT THE PARAMETERS OF A 500-CHANNEL CABLE SUPERHIGHWAY. THIS TOO IS AN OBJECTIVE OF THE BILL.

LET ME AGAIN REITERATE, I AM NOT AGAINST THE OBJECTIVES OF THE BILL, I AM AGAINST SPENDING OVER

$1 BILLION DOLLARS OF NEW TAXPAYER MONEY FOR GOVERNMENT RESEARCH AND DEVELOPMENT WHEN IT ALREADY EXISTS OR IS BEING DEVELOPED BY THE PRIVATE SECTOR.

I ALSO HAVE ONE MORE QUESTION: WHY ARE WE ABOUT TO AUTHORIZE $1.3 BILLION WHEN, JUST TWO YEARS AGO THIS BODY AUTHORIZED ALMOST $3 BILLION DOLLARS FOR ESSENTIALLY THE SAME APPLICATIONS? WHY MUST WE AUTHORIZE ADDITIONAL FUNDS FOR 5 MORE YEARS WHEN WE STILL HAVE MONEY AUTHORIZED UNTIL THE YEAR 1996?

MR. CHAIRMAN WE SHOULD KEEP THE GOVERNMENT OUT OF THE PRIVATE SECTOR AND SAVE THE TAXPAYERS $1.3 BILLION DOLLARS. WE NEED TO STOP UNNECESSARY SPENDING AND ADDRESS DEBT REDUCTION NOT DEFICIT INCREASES.

Mr. JOHNSON of Texas. Thank you.

I would like to add that Mr. Walker and I are in agreement that it seems to me impractical that the U.S. Government try to fund things that can be funded privately. I've counted the word "develop" over 20 times in this bill, and I'd like to know how the Government can develop something better than the private sector can develop it. From past experience, I have not seen that to work real well.

And, you know, in regard to section 307, in particular, the universities in Texas are already connected by INTERNET through THEnet and all the K–12 teachers have access to that program. And the best part of it was it was completed without Federal funds, which just makes the point, I believe.

And Microsoft and Time–Warner are collaborating to champion multimedia applications, and their joint venture will establish compatible software and hardware to fit the parameters of a 500-channel cable superhighway. And this, too, is an objective of the bill. I'd just like to be sure that we use as much private money as possible.

And I thank you for offering this amendment because I think if you hadn't, we probably would have, and so it's a good amendment.

Thank you, Mr. Chairman, for allowing me the time.

Mr. BOUCHER. Thank you very much, Mr. Johnson.

Does the gentleman from Minnesota seek recognition? The gentleman from Minnesota.

Mr. MINGE. Thank you, Mr. Chairman.

I have just three things I'd like to mention in an opening statement. First, I do have two amendments that are designed to protect copyright-intellectual property rights with respect to these developments. Second, I am proud to be able to say that I was able to use this type of technology last week to conduct a town meeting in Minnesota at the same time I was sitting in the chairman's anteroom to this committee room.

And it was a town meeting that maybe started out a little bit stilted in the sense that people in Minnesota were unsure as to how to handle a Member of Congress who was appearing on an interactive TV. Yet, it was a successful meeting and it was a good way for us to show how we can economize in the use of time and avoid the tremendous travel expense that is associated with going back and forth to conduct what occasionally is an infrequent meeting.

Finally, I'd like to associate myself with the comments made by Mr. Walker from Pennsylvania at the outset of these remarks, and look forward to the refinements in the legislation as it moves to the full committee hearing.

Mr. BOUCHER. Thank you very much, Mr. Minge.

The Chair now asks unanimous consent that the subcommittee print, the amendment in the nature of a substitute, be considered as the subcommittee markup vehicle and original text for purposes of the markup. Without objection, the amendment in the nature of a substitute will be considered as read and open for amendment at any point, and will be the original text and subcommittee markup vehicle.

The Chair would inquire if members seek recognition for the purpose of offering amendments to the amendment in the nature of a substitute. And the Chair recognizes the gentleman from Minnesota, Mr. Minge.

Mr. MINGE. Yes, thank you, Mr. Chairman.

I have two amendments which I believe have been distributed, and each of these deal with the subject that I just referred to; that is, intellectual property rights in connection with the information highway concept.

And at this time I would move that this committee accept the first amendment, and the——

Mr. BOUCHER. Which amendment is that, Mr. Minge?

Mr. MINGE. Okay, that's the amendment that refers to page 22, line 16——

Mr. BOUCHER. All right.

Mr. MINGE [continuing]. And includes the language following——

Mr. BOUCHER. Yes, the clerk will report that amendment.

The CLERK. "Page 22, line 16, insert: 'including, if technologically feasible, systems with capabilities' "——

Mr. BOUCHER. Without objection, that amendment will be considered as read.

[The information follows:]

(C)

AMENDMENT OFFERED BY MR. MINGE TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 1757

Page 22, line 16, insert ", including, if technologically feasible, systems with capabilities for electronically identifying copyrighted works and for electronically indicating whether any permission which is required by title 17, United States Code, has been granted by the copyright owner" after "in electronic form".

Mr. **Boucher**. And the gentleman from Minnesota will be recognized for 5 minutes in support of the amendment.

Mr. **Minge**. Basically, what this amendment does is simply recognize existing U.S. copyright law in this particular act. So that as we develop this information age and the capability to transmit and share information electronically that previously has been, by and large, in print form, we also recognize the copyright law.

And one thing that's important in this amendment is to recognize that we are doing this to the extent it's technologically feasible. So we are not saying that the copyright law has to be observed in this regard if it is not feasible. This is language that we have reviewed with people in the industry, and it is language that is acceptable to them and we feel that it would be workable in the administration of this program.

Mr. **Boucher**. Will the gentleman yield?

Mr. **Minge**. Yes.

Mr. **Boucher**. I would like to express the subcommittee's appreciation to the gentleman for offering this amendment. We have been pleased to work with you and your staff in constructing it. I think it is a positive step toward ensuring the integrity of copyrights where the information that is copyrighted is transmitted over the network, and I'm pleased to recommend the adoption of this amendment by the subcommittee.

Do other members seek recognition on the amendment?

[No response.]

If not, the question occurs on the amendment offered by the gentleman from Minnesota. Those in favor will say aye.

Those opposed no.

The ayes have it and the amendment is agreed to.

And the gentleman is recognized—well, the clerk will report the second amendment.

The **Clerk**. "Page 26, lines 15 and 16, strike 'computer, telecommunications,' and insert in lieu thereof 'computer hardware, computer software, telecommunications, publishing.' "

[The information follows:]

(D)

AMENDMENT OFFERED BY MR. MINGE TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 1757

Page 26, lines 15 and 16, strike "computer, telecommunications," and insert in lieu thereof "computer hardware, computer software, telecommunications, publishing,".

Mr. **BOUCHER**. The gentleman is recognized for 5 minutes in support of the amendment.

Mr. **MINGE**. Thank you. Thank you, Mr. Chairman.

The amendment that's proposed at this point makes two changes. One is a modest change in that I have split computer into computer hardware and software, simply to designate that we have different types of computer equipment and also technology that we're discussing, and that if we are going to have a research and reporting feature to this bill, so that Congress and the public is aware of how the bill is operating, we make that clear that we want that type of information in both areas.

Second, the change is made by adding the word "publishing," and "publishing" is in a sense a word of art or term of art here, but what we're asking is that in the process of making this study and reporting back that that feature of the program also be addressed or recognized, so that we have complete information and a complete analysis that's available to us as a part of ongoing research and use of this program.

Mr. **BOUCHER**. Would the gentleman yield?

Mr. **MINGE**. Yes.

Mr. **BOUCHER**. I would also like to commend the gentleman for his offering of this amendment, with respect to which we have also cooperated in its construction, adding to the advisory committee that will make continued reports to the administration and to the Congress on the implementation of the program a number of industries that are vitally affected by this program and that will be expected to contribute to it.

And I'm pleased for that reason to commend this amendment to the subcommittee and urge its adoption.

Do others desire recognition on the amendment? The gentleman from Pennsylvania.

Mr. **WALKER**. Mr. Chairman, it's largely technical and I'm just trying to gather the implications of all of this.

Do I understand that all of these people are being added by splitting the computer industry—and I think the gentleman makes a good point that it is two entirely different things, hardware and software, but are we adding representatives to the advisory committee at that point? I mean, in each of these cases, each time we make the split, is that one more person that's now added to the advisory committee?

Mr. **MINGE**. OK, it would not be required that we add additional people to the advisory committee because we could have one person that had experience in both areas.

Mr. **WALKER**. Well, but telecommunications and publishing—I mean, what I'm adding up here is we've got an advisory committee that already has representatives of the research community, the library community, education at all levels—I assume that means elementary, secondary, college, graduate; I assume that it would mean also a specialized school such as vocational schools and all of that when you say "education at all levels." We have consumer and public interest groups. That's a couple of more people. We have network providers. We have now, with this amendment, we have computer hardware, computer software, telecommunications, publishing, and information industries.

We're getting a pretty fair sized advisory committee here, and I just wonder, the gentleman said that the term "publishing" is kind of a word of art here. I mean, publishing is very definite. I mean, you have specialized and nonspecialized publishing which would have decidedly different views of some of these questions of high performance computing networks. Somebody who's publishing "Motor Trend" magazine and someone who's publishing a newspaper in my district would have decidedly different views from the standpoint of publishing about what they want these high computer—or high performance computer networks to do for them.

But I'm just trying to gather here what it is we are asking this advisory committee to do and what we're asking it to be as we add more and more people.

Mr. **BOUCHER**. Would the gentleman yield?

Mr. **WALKER**. Sure, I'd be happy to yield to the chairman.

Mr. **BOUCHER**. I thank the gentleman for yielding.

This committee has a very important function. It will be directed to report on a periodic basis to the administration and to the Congress, first of all, on the progress in implementing the high performance computing and high speed networking program, carrying out the various research directives that we have for new networking technologies and for specific applications.

And even more importantly, in my judgment, for recommending to the administration and to the Congress additional applications that over time would be deserving of Federal research support. And I rather suspect that you will see over time further iterations of what we are undertaking today, and that is building in Federal support for what the private sector essentially tells us is needed, identifying through this advisory committee new applications that we should be considering and that we should be supporting.

That, by the way, is by and large the process by which this legislation came forward. There was not a formal advisory committee, but it was recommendations from private industry that led to the precise kinds of research that we're setting forth in this legislation, and, specifically, to the applications for which research funding will be directed in this bill. And that, in turn, is why we have such a large group of private sector companies and various industries supporting the legislation.

What we're seeking to do essentially through this committee is formalize that process. That worked well on an informal basis and I think can be expected to work better once the committee is formalized and serves as an external advisory body to the Office of Science and Technology Policy.

And the simple purpose of the gentleman from Minnesota's amendment is to make sure that some people who serve on that committee have expertise in these various areas: in computer software, in telecommunications, and in publishing. Now I endorse that because it doesn't necessarily add to the membership. Some people who serve on that committee can have multiple skills and multiple sets of knowledge, and could accomplish with one chair on that committee many of these various representative tasks. And so I do not believe it necessarily will lead to an increased number of members, but even if it does, I, for one, would say to the gentleman I don't see the harm in that.

I think it's a salutary effort and one that should be supported.

Mr. WALKER. Mr. Chairman, if you will, but it does go to my concern, as I expressed at the outset of this bill, and that is that the moment that we begin to become involved in what are essentially private sector activities we do, in fact, and impact and that impact we hope would be positive, but the law of unintended consequences also falls in here and sometimes the impact we have is adverse.

For example, I mean, I don't have a problem with including the word "publishing," but I will tell you, you could well have someone who is a member of this advisory committee who has experience in the publishing field who could do massive harm because it would be a one-dimensional experience. And the publishing field is vast. I mean, you go everywhere from book publishers to newspaper publishers to magazine publishers. In magazines you have specialized magazines and you have general purpose magazines. You have a whole series of things which a publication would desire.

Now you could have somebody who's making all kinds of recommendations here as a member of this official panel that would have a very narrow part of that schematic in their experience level, and, therefore, could harm a lot of other sectors simply because their experience is one-dimensional in nature.

I guess I'm seeking to satisfy myself that we have some safeguards that the recommendations being made here that will essentially have to be implemented by the private sector are not undermined by the way in which we're establishing an advisory panel, which as I read on page 28 is going to take public testimony, make recommendations, and do a lot of things here which could be very definitely policy oriented.

Mr. BOUCHER. Would the gentleman yield?

Mr. WALKER. Sure, I'd be happy to yield.

Mr. BOUCHER. I'll do my best to offer the gentleman that reassurance which he is seeking. On page 26, at line 17, the qualifications for people who serve on this advisory committee are rather precisely set forth, and it says that they must be individuals who are specifically qualified to provide the Director with advice and information on high performance computing and on applications of computing and networking. And that would suggest that someone who simply has experience in the art of publishing itself would probably not be qualified to serve on this committee. It would have to be someone who understood publishing, but also was skilled in the interface between publishing and electronics and networking and high performance computing. And I think that would be a rather special set of skills which, quite frankly, not a large number of people would possess.

The Director of the Office of Science and Technology Policy will make that choice and will be directed to look at this set of criteria in making that decision, and I would think we should take a measure of comfort that it will be people who understand the interface between publishing and high performance computing and networking who would be selected.

Mr. WALKER. Well, if I might, Mr. Chairman, I thank you for that, and I think that does help explain the gentleman's amendment. I will tell you, though, as someone whose spouse is involved in education, you are going to have a variety of different people who have those kinds of skills in the educational field, all of whom are going to have a little different iteration on what they believe. When we talk up here about education at all levels, you're going to give the Director a very difficult assignment to find the kind of people who can advise him within the educational field there because while in some of these areas that may be a very narrow group of people, I can assure you that in the education field the people who have information on high performance computing and the applications of computing and networking are vast and have a multitude of ideas about how this should be done. And the selection of those people is very definitely going to drive some policy decisions.

You know, perhaps that's what we want to accomplish here, but I think we are, in fact, setting up a difficult scenario for the Director.

I thank you, Mr. Chairman.

Mr. BOUCHER. Thank you, Mr. Walker.

Does anyone else seek recognition on the amendment offered by the gentleman from Minnesota?

[No response.]

The question then occurs on the amendment. Those in favor will say aye.

Those opposed no.

The ayes have it and the amendment is agreed to.

Do other members seek recognition for purposes of offering an amendment? The gentleman from Pennsylvania.

Mr. WALKER. Mr. Chairman, I have an amendment at the desk.

Mr. BOUCHER. The clerk will report the amendment.

The CLERK. "Page 4, after line 25, insert the following new paragraph"——

Mr. WALKER. I ask unanimous consent that the amendment be considered as read.

Mr. BOUCHER. Without objection.

[The information follows:]

AMENDMENT OFFERED BY MR. WALKER TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 1757

Page 4, after line 25, insert the following new subsection:

"(d) NONDEVELOPMENTAL ITEMS.—In carrying out activities under this Act, Federal departments and agencies shall purchase nondevelopmental items whenever possible.

Page 35, line 3, strike "(11)" and insert in lieu thereof "(12)".

Page 36, line 9, strike "and".

Page 36, line 15, strike "and".

Page 36, line 15, insert "and" at the end thereof.

Page 36, after line 15, insert the following new subparagraph:

(F) by inserting after such paragraph (10) the following new paragraph:

"(11) 'Nondevelopmental item' has the meaning given such term in section 2325(d) of title 10, United States Code; and";

Mr. BOUCHER. And the gentleman is recognized for 5 minutes.

Mr. WALKER. Mr. Chairman, I believe this amendment will protect the taxpayers, benefit private investment by high technology companies, and direct R&D spending where it is truly needed.

This amendment would require the government agencies to purchase existing nondevelopmental items when they exist—and let me emphasize that last point—when they exist. By nondevelopmental items, I mean any item that is available in the commercial marketplace. The goal here is to ensure that the government is not funding R&D with taxpayers' money where existing commercial products already are in place, exist, and are eligible to be purchased. Of course, where a product or service does not exist, the HPCC agencies would be authorized to spend government money, government funds, for R&D where there is no existing product.

I know that in the chairman's substitute bill he has expressed a desire to ensure competition in the marketplace, and I feel that this language only builds on this idea, and I urge the members to support it.

Mr. BOUCHER. Would the gentleman yield?

Mr. WALKER. Sure, I would be happy to yield.

Mr. BOUCHER. I would like to compliment the gentleman on the amendment, and I think it does, in fact, carry forward the policy which he has announced, which is very consistent with the purposes of our legislation. And I'm pleased to encourage the adoption of the amendment by the subcommittee.

Do other members seek recognition?

[No response.]

The question then occurs on the amendment offered by the gentleman from Pennsylvania. Those in favor will say aye.

Those opposed no.

The amendment—the ayes have it and the amendment is agreed to.

Do other members seek recognition for purposes of offering an amendment?

[No response.]

The Chair seeks recognition and would offer an amendment dealing with the NTIA, and would ask that that be distributed if it has not been already. The amendment has been distributed.

I would ask unanimous consent that the reading of the amendment be dispensed with. Without objection, the reading of the amendment will be dispensed with.

[The information follows:]

(B)

F:\M\BOUCHE\BOUCHE.045 H.L.C.

AMENDMENT OFFERED BY MR. BOUCHER TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 1757

Page 8, lines 22 and 23, strike "and the National Telecommunications and Information Administration".

Page 9, lines 14 through 16, strike ", the National Telecommunications and Information Administration,".

Page 11, line 4, strike "(1)".

Page 11, lines 9 through 13, strike paragraph (2).

Mr. MINGE. Could I ask, Mr. Chairman, if that amendment is on the table here?

Mr. BOUCHER. Yes, it is on the table. I would say to the gentleman that I intend to explain it. So we'll provide a thorough description of what the amendment provides.

In the original bill and in the amendment in the nature of a substitute, the effort was made by the subcommittee to authorize all of the programs that would be carried forward under this legislation, including departments that are not under the direct legislative jurisdiction of the subcommittee. We did that in order to promote efficiency and to offer, frankly, a convenience to other committees that then could forego the necessity of having to obtain a sequential referral of the legislation.

That process has worked relatively well. However, we were informed just within the last 2 days that the Telecommunications Subcommittee of the Committee on Energy and Commerce intends later during this Congress to enact a comprehensive authorization bill for the NTIA, an agency that provides telecommunications information within the Department of Commerce, and that agency is squarely within the jurisdiction of that subcommittee.

Energy and Commerce, therefore, requested that this subcommittee not include the authorization for NTIA in this measure, with the understanding that that comprehensive measure reauthorizing all of the programs of that agency would include this authorization as well. And that, I think, is a request that we should respect.

So the purpose of this amendment is to remove the NTIA authorization for the direct connections program from the amendment in the nature of a substitute.

Do other members seek recognition to discuss this amendment? [No response.]

If not, the question occurs on the amendment. Those in favor will say aye.

Those opposed no.

The ayes have it and the amendment is agreed to.

There is a second amendment that I would offer at this time, which is the en bloc amendment dealing with authorization levels. And I would ask unanimous consent that the reading of this amendment be waived. Without objection, so ordered.

[The information follows:]

(A)

F:\M\BOUCHE\BOUCHE.044 H.L.C.

AMENDMENTS OFFERED BY MR. BOUCHER TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE

Page 11, line 5, strike "There" and insert in lieu thereof "From sums otherwise authorized to be appropriated, there".

Page 11, line 9, strike "There" and insert in lieu thereof "From sums otherwise authorized to be appropriated, there".

Page 12, line 18, strike "There" and insert in lieu thereof "From sums otherwise authorized to be appropriated, there".

Page 16, line 6, strike "There" and insert in lieu thereof "From sums otherwise authorized to be appropriated, there".

Page 20, line 23, strike "There" and insert in lieu thereof "From sums otherwise authorized to be appropriated, there".

Page 23, line 12, strike "There" and insert in lieu thereof "From sums otherwise authorized to be appropriated, there".

Page 25, line 24, strike "There" and insert in lieu thereof "From sums otherwise authorized to be appropriated, there".

Mr. **BOUCHER**. And I will explain this amendment. It is necessary in order to avoid double authorizations, because the funds that we would seek to authorize in the amendment in the nature of a substitute for the various agencies that will carry out the high performance and high speed networking program are already built into the budgets and authorization levels of the agencies that will carry these out. That happens through other statutes. And so providing that direct authorization in this bill would, in effect, constitute double authorization.

And the purpose of this amendment, therefore, is to say that these funds will be from authorizations otherwise contained in other statutes for these agencies. That is the explanation of the amendment.

I would ask if members seek recognition on that measure.

Mr. **WALKER**. Mr. Chairman.

Mr. **BOUCHER**. The gentleman from Pennsylvania.

Mr. **WALKER**. As I stated at the beginning of this hearing, I congratulate you for this amendment and I really do feel that it is an amendment which will give us an additional chance of passing this bill with, hopefully, broad-based support.

I say that because add-on funding would probably result in a lot of controversy about the bill, whereas I think the importance of what the chairman and Mr. Boehlert are attempting to achieve here is to formulate a new policy and a policy that will drive us into some new technology investments for the next century.

I think we have a much better chance of getting those policies enacted if we're not in a fire fight over the funding questions, and in this particular case this bill will be able to be represented now as a bill which represents no add-on authorization, and I think that that makes it far easier to discuss the policies involved.

So I thank you for your efforts in this regard. I think it strengthens the bill markedly.

Mr. **BOUCHER**. I would thank the gentleman for his comments and point out that this step is precisely the step that was taken when the High Performance Computing Act was enacted in 1991. That program also was—contained authorizations that were based upon authorizations that were provided through other statutes to the agencies that carried it out. And what we are doing here is entirely consistent with the procedure adopted in 1991.

Do other members seek recognition on this amendment?

[No response.]

If not, the question occurs on the amendment. Those in favor will say aye.

Those opposed no.

The ayes have it and the amendment is agreed to.

Do other members seek recognition for purposes of offering amendments to the amendment in the nature of a substitute?

[No response.]

The Chair now recognizes the gentleman from New York.

Mr. **BOEHLERT**. Mr. Chairman, I move that the subcommittee report the bill H.R. 1757 as amended. Furthermore, I move to instruct the staff to prepare the subcommittee report, to make any necessary technical and conforming amendments, and that the chairman take all necessary steps to bring the bill before the full committee for consideration.

Mr. BOUCHER. The question occurs on the motion of the gentleman from New York. Those in favor will say aye.

Those opposed no.

The ayes have it and the bill is reported to the full committee in accordance with the instructions contained in the motion.

There being no further business to come before the subcommittee this morning, this meeting is adjourned.

[Whereupon, at 11:04 a.m., the subcommittee adjourned subject to the call of the Chair.]

FULL COMMITTEE MARKUP OF H.R. 1757—THE HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993

WEDNESDAY, JUNE 30, 1993

House of Representatives,
Committee on Science, Space, and Technology,
Washington, DC.

The committee met, pursuant to call, at 10:11 a.m., in room 2318, Rayburn House Office Building, Hon. George E. Brown, Jr. (chairman) presiding.

The Chairman. The committee will come to order.

And we'd like to request that the members take their seats.

We have an important piece of legislation before us this morning which we will take up very shortly, but before we do that I would like to welcome the newest member of our committee, Congressman Peter Barca from Wisconsin, who fills the vacancy left by Secretary Aspin when he was appointed Secretary of Defense.

I would like to ask, on behalf of the Democratic Caucus of this committee, to ask unanimous consent to appoint Mr. Barca to fill vacancies on the Science Subcommittee and the Technology, Environment, and Aviation Subcommittee. If there are no objections—and I hear none—that will be the order. And Mr. Barca is now fully involved in the work of the committee.

I want to extend a warm welcome to him, and we look forward to working with you. If there's no objection, I'll recognize you for one minute out of order, so that you can respond by saying what a great committee this is. [Laughter.]

Mr. Barca. I want to respond by saying what a great chairman we have. [Laughter.]

The Chairman. That's even better. [Laughter.]

Mr. Barca. I thought that would ring a bell.

The Chairman. The Chair now calls up for consideration H.R. 1757, the High Performance Computing and High Speed Networking Applications Act of 1993. The Chair asks unanimous consent that the text of H.R. 1757 as reported by the Subcommittee on Science be considered as original text for the purposes of markup. And, without objection, it is so ordered.

[The information follows:]

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, DC 20515

June 18, 1993

MEMORANDUM

TO: **The Honorable George E. Brown, Jr., Chairman**

FROM: **The Honorable Rick Boucher, Chairman**
Subcommittee on Science

SUBJ: **Subcommittee Report on H.R. 1757, the High Performance Computing and High Speed Networking Applications Act of 1993**

The Subcommittee on Science has completed consideration of H.R. 1757. On Thursday, June 17, 1993, the Subcommittee ordered the bill, as amended, reported to the Full Committee for further consideration by voice vote. A copy of the bill as reported, a section-by-section analysis of that bill, and a description of differences between the bill as introduced and the bill as reported are attached for your review.

H.R. 1757 was introduced by Subcommittee Chairman Rick Boucher and 18 original cosponsors on April 22, 1993. The bill was referred solely to the Committee on Science, Space, and Technology and subsequently to the Subcommittee on Science. The text of H.R. 1757 was developed on the basis of testimony from a February 2, 1993 hearing before the Subcommittee on Science which explored the need for new legislation to capture fully the promise of the High Performance Computing Act adopted in 1991.

The Subcommittee held hearings on the bill on April 27, May 6, and May 11, 1993 to obtain the views of the Administration; individuals from the telecommunications, computer, software, information, and network provider industries; users of network services from the research and education communities; and individuals representing the health sciences and libraries. These witnesses expressed strong support for the goals and focus of the legislation, and provided constructive recommendations for modifications to the bill.

The Subcommittee met for consideration of H.R. 1757 on June 17, 1993. The Subcommittee amended and then adopted, by voice vote, an amendment in the nature of a substitute to H.R. 1757. The major changes made to the bill include:

- redesignating the bill as the "National Information Infrastructure Act of 1993";
- designating all authorizations under the bill as coming from sums authorized in other statutes and modifying the authorization levels to conform more closely to the

Administration's recommendations:

- deleting provisions which established new staff positions at the Office of Science and Technology Policy and assigned responsibilities to those staff positions;
- clarifying requirements for devising the means to protect copyrighted materials in electronic form;
- requiring that data communications networks be developed through purchase of standard commercial services whenever feasible and that, for other activities supported under the bill, commercially available items be purchased whenever possible;
- expanding representation on the advisory committee for the computing and networking program established by the bill to include representatives of the computer hardware, computer software and publishing industries, and adding a requirement that the committee formally solicit views from outside government on the planning and implementation of the programs established by the bill;
- clarifying conditions under which use of federal test bed networks is restricted and establishing a process to define the date on which restrictions are to be applied; and
- requiring the President to designate a lead agency to implement activities related to dissemination of government information and to issue policy guidelines for relevant federal programs.

H.R. 1757, AS REPORTED BY THE SUBCOMMITTEE ON SCIENCE

Strike all after the enacting clause and insert in lieu thereof the following:

SECTION 1. SHORT TITLE.

This Act may be cited as the "National Information Infrastructure Act of 1993".

SEC. 2. FINDINGS.

The Congress finds that—

(1) high-performance computing and high-speed networks have proven to be powerful tools for improving America's national security, industrial competitiveness, research capabilities, and ability to make a wide array of information available for a variety of applications;

(2) Federal programs, such as the High-Performance Computing Program and National Research and Education Network established by Congress in 1991, are vital to the maintenance of United States leadership in high-performance computing and high-speed network development, particularly in the defense and research sectors;

(3) high-performance computing and high-speed networking have the potential to expand dramatically access to information in many fields, including

education, libraries, government information dissemination, and health care, if adequate resources are devoted to the research and development activities needed to do so;

(4) high-performance computing and high-speed networking have the potential to expand opportunities for participation for Americans who have disabilities and to improve equality of opportunity, full participation, independent living, and economic self-sufficiency for Americans with disabilities;

(5) the Federal Government should ensure that the applications achieved through research and development efforts such as the High-Performance Computing Program directly benefit all Americans;

(6) the Federal Government should stimulate the development of computing and networking applications and support wider access to network resources so that the benefits of applications so developed can reach the intended users throughout the Nation, including users with disabilities; and

(7) a coordinated, interagency undertaking is needed to identify and promote applications of computing and networking advances developed by the High-Performance Computing Program which will provide large economic and social benefits to the Na-

tion, including new tools for teaching, the creation of digital libraries of electronic information, the development of standards and protocols to make the stores of government information readily accessible by electronic means, and computer systems to improve the delivery of health care.

SEC. 3. APPLICATIONS OF THE HIGH-PERFORMANCE COMPUTING PROGRAM.

The High-Performance Computing Act of 1991 is amended by adding at the end the following new title:

"TITLE III—APPLICATIONS OF COMPUTING AND NETWORKING

"SEC. 301. ESTABLISHMENT OF APPLICATIONS PROGRAM.

"(a) ESTABLISHMENT.—The Director, through the Federal Coordinating Council for Science, Engineering, and Technology, shall, in accordance with this title—

"(1) establish a coordinated interagency applications program to develop applications of computing and networking advances achieved under the Program described in section 101, that are designed to be accessible and usable by all persons in the United States, including historically underserved populations and individuals with disabilities, in the fields of education, libraries, health care, the provision of government information, and other ap ropriate fields; and

"(2) develop a Plan for Computing nd Networking Applications (hereafter in this titl referred to as the 'Plan') describing the goals and roposed activities of the applications program e ablished under paragraph (1), taking into cons eration the recommendations of the advisory com ittee on high-performance computing and applica ons established under section 101(b).

The President shall designate the Federal agencies nd departments which shall participate in the applica ons program established under paragraph (1). The app cations program may be administered as part of the rogram established under section 101.

"(b) COLLABORATION WITH NON-FEDERAL E TITIES.—To the maximum extent possible, the applica ons program shall involve cost sharing and partner ips among participating Federal departments and ager es, State and local governments, and private sector ent es.

"(c) INTEROPERABLE INFORMATION SYSTEMS.— In selecting projects for support under this title, special on sideration shall be given to projects which will pro ote development of interconnected and interoperable info ation systems.

"(d) NONDEVELOPMENTAL ITEMS.—In carrying out activities under this Act, Federal departments and agencies shall purchase nondevelopmental items whenever possible.

"SEC. 302. PLAN FOR COMPUTING AND NETWORKING APPLICATIONS.

"(a) REQUIREMENT.—The Plan shall contain a statement of steps which should be taken to implement the applications program established under section 301(a)(1) for the fiscal year in which the Plan is submitted and the succeeding four fiscal years, and shall be submitted to the Congress within one year after the date of enactment of this title. The Plan shall be revised and resubmitted to the Congress at least once each two years thereafter.

"(b) CONTENTS.—The Plan shall—

"(1) establish the goals and priorities for the applications program established under section 301(a)(1), consistent with this Act;

"(2) set forth the specific responsibilities of each Federal agency and department participating in the applications program established under section 301(a)(1) to achieve the goals and priorities established under paragraph (1) of this subsection; and

"(3) describe the recommended levels of Federal funding required for each agency and department to carry out the specific responsibilities set forth in paragraph (2) of this subsection.

"(c) PROGRESS IN IMPLEMENTING PLAN.—(1) Accompanying the initial submission of the Plan shall be—

"(A) a summary of the achievements of Federal efforts during the preceding fiscal year to develop computing and networking applications and to advance the technologies on which the applications depend; and

"(B) any recommendations regarding additional action or legislation which may be required to assist in implementing the Plan.

"(2) Accompanying each subsequent submission of the Plan shall be—

"(A) a summary of the achievements of Federal efforts since the previous submission of the Plan to develop computing and networking applications and to advance the technologies on which the applications depend, including an estimate of the number and the demographic diversity of users served in each application;

"(B) an evaluation of the progress made toward achieving the goals and priorities established under subsection (b)(1);

"(C) a summary of problems encountered in implementing the Plan; and

"(D) any recommendations regarding additional action or legislation which may be required to assist in implementing the Plan.

"SEC. 303. RESPONSIBILITIES OF THE FEDERAL COORDINATING COUNCIL FOR SCIENCE, ENGINEERING, AND TECHNOLOGY.

"The Federal Coordinating Council for Science, Engineering, and Technology shall—

"(1) develop the Plan as provided in section 301(a)(2);

"(2) coordinate the activities of Federal agencies and departments undertaken pursuant to the Plan and report at least annually to the President, through the Chairman of the Council, on any recommended changes in agency or departmental roles that are needed better to implement the Plan; and

"(3) assess, prior to the President's submission to the Congress of the annual budget estimate, each agency and departmental budget estimate for consistency with the Plan and make the results of that assessment available to the appropriate elements of the Executive Office of the President, particularly the Office of Management and Budget.

"SEC. 304. NOTIFICATION REQUIREMENT.

"(a) REQUIREMENT.—Each Federal agency and department designated by the President under section 301(a) as a participant in the applications program shall, as part of its annual request for appropriations to the Office of Management and Budget—

"(1) identify each element of its activities which—

"(A) contributes primarily to the implementation of the Plan; or

"(B) contributes primarily to the achievement of other objectives but aids Plan implementation in important ways; and

"(2) identify the portion of its request for appropriations that is allocated to each such element.

"(b) OFFICE OF MANAGEMENT AND BUDGET REVIEW.—The Office of Management and Budget shall review each submission received under this section in light of the goals, priorities, and agency and departmental responsibilities set forth in the Plan. The President's annual budget request shall include a statement of the portion of each appropriate agency or department's annual budget request that is allocated to efforts to achieve the goals and priorities established under section 302(b)(1).

"SEC. 305. NETWORK ACCESS.

"(a) CONNECTIONS PROGRAM.—The Plan shall include programs administered by the National Science Foundation to—

"(1) foster the development of network services in local communities which will connect institutions of education at all levels, libraries, museums, and State and local governments to each other; and

"(2) provide funds for the purchase of network services to entities described in paragraph (1), or organizations representing such entities, to connect to the Internet.

Such program shall include funding for the acquisition of required hardware and software and for the establishment of broadband connections to the Internet. Not more than 75 percent of the cost of any project for which an award is made under this subsection shall be provided under this Act.

"(b) TRAINING.—The Plan shall include programs administered by the National Science Foundation and other appropriate agencies and departments to train teachers, students, librarians, and State and local government personnel in the use of computer networks and the Internet. Training programs for librarians shall be designed to provide skills and training materials needed by librarians to instruct the public in the use of hardware and software for accessing and using computer networks and the Internet. Training programs shall include programs designed for individuals with disabilities.

"(c) REPORT.—The Director shall, within one year after the date of enactment of this title, submit a report to Congress which shall include—

"(1) findings of an examination of the extent to which the education and library communities and State and local government have access to the Internet, including the numbers and the geographic distribution, by type, of institutions having access, and including the numbers of institutions having human/computer interfaces suitable for use by individuals with disabilities;

"(2) a statement of the extent to which broadband connections to the Internet exist for the education and library communities and State and local governments, including the numbers and the geographic distribution, by type, of institutions having access;

"(3) an assessment of the factors limiting access by institutions of education at all levels, libraries, and State and local governments to the Internet and an estimate of the cost of providing universal broadband access for those institutions to the Internet; and

"(4) recommendations for collaborative programs among Federal, State, and local governments and the private sector to expand connectivity to the Internet for educational institutions, libraries, and State and local governments.

"(d) AUTHORIZATION OF APPROPRIATIONS.—From sums otherwise authorized to be appropriated, there are authorized to be appropriated to the National Science Foundation for the purposes of this section, $15,000,000 for fiscal year 1994, $30,000,000 for fiscal year 1995, and $50,000,000 for fiscal year 1996.

"SEC. 306. RESEARCH IN SUPPORT OF APPLICATIONS.

"(a) IN GENERAL.—The Plan shall specify the basic and applied research and human resource development activities in areas, such as computer science and engineering, mathematics, computer visualization, and human cognition, that will provide the foundation for achieving the applications included in the Plan. The Plan shall include basic and applied research activities related to the long-range social and ethical implications of applications of high-speed networking and high-performance computing. The Plan shall specify those activities included in the Program under title I which contribute to the development of applications included in the Plan.

"(b) NETWORK SECURITY AND PRIVACY.—The Plan shall specify research programs needed to create means to—

"(1) ensure the security and privacy of transmissions over the Internet and the integrity of digital information accessed via the Internet; and

"(2) facilitate the management and protection of copyrighted information which is accessed via the Internet.

"(c) EASE OF INTERNET USE.—The Plan shall specify research programs needed to develop and demonstrate human/computer interfaces that will simplify access to and use of the Internet by nonspecialists in computing and networking technologies and by individuals with disabilities.

"(d) AUTHORIZATION OF APPROPRIATIONS.—From sums otherwise authorized to be appropriated, there are authorized to be appropriated for the purposes of this section, $6,000,000 for fiscal year 1994, $15,000,000 for fiscal year 1995, $20,000,000 for fiscal year 1996, $20,000,000 for fiscal year 1997, and $20,000,000 for fiscal year 1998.

"SEC. 307. APPLICATIONS FOR EDUCATION.

"(a) IN GENERAL.—The Plan shall specify projects to develop and apply computing and networking technologies for use in education at all levels from early childhood education through higher education, including projects for the education and training of individuals with disabilities. The National Science Foundation shall be the lead agency for implementing the activities required by this section, and shall consult with the Department of Education in implementing those activities. Activities under this section shall include—

"(1) projects, including support for acquisition of required computer hardware and software, that demonstrate the educational value of the Internet, including cost effectiveness, in providing for advances in distance learning and electronic classrooms, facilitating nationwide communication among educators and students, access to databases of information in digital format, and access to innovative curricular materials;

"(2) development, testing, and evaluation of computer systems, computer software, and computer networks for—

"(A) teacher training, including teachers in special education programs; and

"(B) informal education outside of school, including workforce training in mathematics, science, and technology and in specific job-related skills, including literacy; and

"(3) development, testing, and evaluation of advanced educational software and of network-based information resources.

"(b) ELEMENTARY AND SECONDARY EDUCATION.—In accordance with subsection (a), applications for elementary, secondary, and vocational/technical education shall be designed to complement and strengthen ongoing national, State, and local educational restructuring and reform activities and shall include—

"(1) projects in computing and networking that—

"(A) provide for network connections among elementary and secondary schools in local regions and connections to the Internet to enable students and teachers to—

"(i) communicate with their peers;

"(ii) communicate with educators and students in institutions of higher education; and

"(iii) access educational materials and other computing resources;

"(B) address the needs of rural populations and of urban communities; and

"(C) address the needs of individuals with disabilities;

"(2) collection and dissemination of information about ongoing elementary and secondary educational projects, including special education projects, based on application of computing and networking technologies, and about other educational resources available over the Internet;

"(3) development and evaluation of undergraduate courses in the educational applications of computing and networking for the instruction of students preparing for teaching careers, including courses that will ensure the early familiarization and training of these students in the use of the Internet; and

"(4) development, testing, and evaluation of educational software designed for collaborative use over the Internet, including tools that will enable classroom teachers easily to adapt software to local conditions.

"(c) COOPERATION.—In carrying out the requirements of this section, the National Science Foundation, the Department of Education, and other Federal agencies participating in such activities shall work with the computer hardware, computer software, and communications industries, authors and publishers of educational materials, State education departments, and local school districts, as appropriate.

"(d) AUTHORIZATION OF APPROPRIATIONS.—From sums otherwise authorized to be appropriated, there are authorized to be appropriated to the National Science Foundation for the purposes of this section, $16,000,000 for fiscal year 1994, $45,000,000 for fiscal year 1995, $60,000,000 for fiscal year 1996, $75,000,000 for fiscal year 1997, and $75,000,000 for fiscal year 1998.

"SEC. 308. APPLICATIONS FOR HEALTH CARE.

"(a) IN GENERAL.—The Plan shall specify projects to develop and apply high-performance computing and high-speed networking technologies for use in the health care sector. The Department of Health and Human Services, through the National Institutes of Health and the Centers for Disease Control and Prevention, shall be the lead agency for implementing the activities required by this section.

"(b) CLINICAL INFORMATION SYSTEMS.—In accordance with subsection (a), applications related to clinical information systems shall include—

"(1) testbed networks for linking hospitals, clinics, doctor's offices, medical schools, medical libraries, and universities to enable health care providers and researchers to share medical images and to develop computer-based records;

"(2) software and visualization technology for visualizing the human anatomy and analyzing diagnostic images and records;

"(3) virtual reality technology for simulating surgical and medical procedures;

"(4) collaborative technology to allow several health care providers in remote locations to provide real-time treatment to patients;

"(5) interactive technologies to allow health care providers to monitor, evaluate, and treat patients in nonclinical settings;

"(6) database technology to provide health care providers with access to relevant medical information and literature;

"(7) database technology for storing, accessing and transmitting patients' medical records while protecting the accuracy and privacy of those records;

"(8) numerical simulation of chemical interactions relevant to reducing the time and cost of drug development;

"(9) three dimensional geometric modeling and artificial intelligence methods for interpreting an array of medical images; and

"(10) complex simulations of sociological populations affected disproportionately by selected diseases or disorders.

"(c) HEALTH INFORMATION TO THE PUBLIC.—In accordance with subsection (a), applications related to delivery of health information to the public shall include—

"(1) development, testing, and evaluation of database and network technologies for the storage of consumer-oriented, interactive, multimedia materials for health promotion, and for the distribution of such materials to public access points, such as community health and human service agencies, Centers for Independent Living established by the Rehabilitation Act of 1973, organizations established by title I of the Technology-Related Assistance for Individuals with Disabilities Act of 1988, schools, and public libraries;

"(2) pilot programs to develop, test, and evaluate the effectiveness and cost efficiency of interactive, multimedia materials to assist patients in deciding among health care options;

"(3) development and demonstration of human/computer interfaces to allow nonspecialists in computing and networking technologies ease of access to and use of databases of health information and networks providing health information service; and

"(4) development, testing, and evaluation of database and network access technologies to provide individuals with health information, including health risk appraisal, preventative medical advice, and disease treatment options, which is oriented to nonhealth professionals and which is customized to take into consideration an individual's medical history.

"(d) HEALTH DELIVERY SYSTEMS AND POPULATION DATA SETS.—In accordance with subsection (a), applications for health delivery systems and for gathering population data sets shall include—

"(1) testbed networks and software that permits collaborative communication among local public and private health and human service providers, such as health centers, clinics, entitlement offices, and school-based clinics, to enable health and human service providers to work together in delivering coordinated services for at-risk populations;

"(2) pilot programs to develop high speed communications networks and software for providing health care providers with—

"(A) immediate, on-line access to up-to-date clinic-based health promotion and disease prevention recommendations from the Centers for Disease Control and Prevention and other Public Health Service agencies; and

"(B) a two-way communications link with prevention specialists in State and local health departments, and other agencies with information germane to clinic-based health promotion and disease prevention; and

"(3) development, testing, and evaluation of database technologies to provide clinicians with access to information to guide and assist them in providing diagnosis, providing treatment, and providing advice regarding health promotion and disease prevention to patients, and to facilitate the gathering of systematic population data sets in compatible formats on the efficacy of treatments and on national health trends.

"(e) AUTHORIZATION OF APPROPRIATIONS.—From sums otherwise authorized to be appropriated, there are authorized to be appropriated to the Secretary of Health and Human Services for the purposes of this section, $22,000,000 for fiscal year 1994, $54,000,000 for fiscal year 1995, $72,000,000 for fiscal year 1996, $90,000,000 for fiscal year 1997, and $90,000,000 for fiscal year 1998.

"SEC. 309. APPLICATIONS FOR LIBRARIES.

"(a) IN GENERAL.—The Plan shall specify projects to develop technologies for 'digital libraries' of electronic information. The National Science Foundation shall be the lead agency for implementing the activities required by this section, and in implementing this section shall take into account the needs of individuals with disabilities.

"(b) DIGITAL LIBRARIES.—In accordance with subsection (a), activities to support the development of digital libraries shall include—

"(1) development of advanced data storage systems capable of storing hundreds of trillions of bits of data and giving thousands of users simultaneous and nearly instantaneous access to that information;

"(2) development of high-speed, highly accurate systems for converting printed text, page images, graphics, and photographic images into electronic form;

"(3) development of database software capable of quickly searching, filtering, and summarizing large volumes of text, imagery, data, and sound;

"(4) encouragement of the development and adoption of common standards and, where appropriate, common formats for electronic data;

"(5) development of computer-based means to categorize and organize electronic information in a variety of formats;

"(6) training of database users and librarians in the use of and development of electronic databases;

"(7) development of means for simplifying the utilization of networked databases distributed around the Nation and around the world;

"(8) development of visualization methods for quickly browsing large volumes of imagery; and

"(9) development of means for protecting copyrighted material in electronic form, including, if technologically feasible, systems with capabilities for electronically identifying copyrighted works and for electronically indicating whether any permission which is required by title 17, United States Code, has been granted by the copyright owner.

"(c) DEVELOPMENT OF PROTOTYPES.—In accordance with subsection (a), the Plan shall provide for the development of prototype digital libraries to serve as testbeds for the systems, software, standards, and methods developed under subsection (b). The development of prototype digital libraries may involve nonprofit, private institutions that collect and maintain specimens, materials, or other items used in research, such as natural history museums. The prototype digital libraries shall be accessible by the public via the Internet. In carrying out this subsection, an evaluation shall be conducted of the suitability and utility of distributing electronic information over the Internet, including cataloging and evaluating the kinds of uses and determining barriers that impair use of the Internet for this purpose.

"(d) DEVELOPMENT OF DATABASES OF REMOTE-SENSING IMAGES.—The National Aeronautics and Space Administration shall develop databases of software and remote-sensing images to be made available over computer networks.

"(e) AUTHORIZATION OF APPROPRIATIONS.—From sums otherwise authorized to be appropriated, there are authorized to be appropriated—

"(1) to the National Science Foundation for the purposes of this section, $8,000,000 for fiscal year 1994, $16,000,000 for fiscal year 1995, $22,000,000 for fiscal year 1996, $32,000,000 for fiscal year 1997, and $32,000,000 for fiscal year 1998; and

"(2) to the National Aeronautics and Space Administration for the purposes of this section. $4,000,000 for fiscal year 1994, $8,000,000 for fiscal year 1995, $10,000,000 for fiscal year 1996, $12,000,000 for fiscal year 1997, and $12,000,000 for fiscal year 1998.

"SEC. 310. APPLICATIONS FOR GOVERNMENT INFORMATION.

"(a) IN GENERAL.—The Plan shall specify projects needed to develop and apply high-performance computing and high-speed networking technologies to provide improved public access to information generated by Federal, State, and local governments, including access by individuals with disabilities.

"(b) LEAD AGENCY.—The President shall designate a lead agency for implementing the activities required by this section. The lead agency shall issue policy guidelines designed to foster—

"(1) a diversity of public and private sources for, and a competitive marketplace in, information products and services based on government information; and

"(2) dissemination of government information to the public on a timely, equitable, and affordable basis and in a manner that will promote the usefulness of the information to the public.

"(c) PROJECTS.—In accordance with subsection (a), projects shall be undertaken which—

"(1) connect depository libraries and other sources of government information to the Internet to enable—

"(A) access to Federal Government information and databases in electronic formats;

"(B) access to State or local government information;

"(C) access to related resources which enhance the use of government information, including databases available through State projects funded pursuant to the Technology-Related Assistance for Individuals with Disabilities Act of 1988; and

"(D) linkages with other libraries and institutions to enhance use of government information; and

"(2) demonstrate, test, and evaluate technologies to increase access to and to facilitate effective use of government information and databases for support of research and education, economic development, and an informed citizenry.

"(d) FEDERAL INFORMATION LOCATOR.—In accordance with subsection (a), an information locator system shall be established which is accessible by the public via the Internet and which provides citations to Federal information and guidance on how to obtain such information.

"(e) AUTHORIZATION OF APPROPRIATIONS.—From sums otherwise authorized to be appropriated, there are authorized to be appropriated for the purposes of this section, $4,000,000 for fiscal year 1994, $12,000,000 for fiscal year 1995, $16,000,000 for fiscal year 1996, $21,000,000 for fiscal year 1997, and $21,000,000 for fiscal year 1998.".

SEC. 4. HIGH-PERFORMANCE COMPUTING AND APPLICATIONS ADVISORY COMMITTEE.

Section 101(b) of the High-Performance Computing Act of 1991 is amended to read as follows:

"(b) HIGH-PERFORMANCE COMPUTING AND APPLICATIONS ADVISORY COMMITTEE.—(1) The Director shall establish an advisory committee on high-performance computing and applications consisting of non-Federal members, including representatives of the research and library communities, education at all levels, consumer and public interest groups, network providers, and the computer hardware, computer software, telecommunications, publishing, and information industries, who are specially qualified to provide the Director with advice and information on high-performance computing and on applications of computing and networking. The recommendations of the advisory committee shall be considered in reviewing and revising the Program described in this section and the Plan required by section 301(a)(2). The advisory committee shall provide the Director with an independent assessment of—

"(A) progress in implementing the Program described in this section and the Plan required by section 301(a)(2);

"(B) the need to revise the Program described in this section and the Plan required by section 301(a)(2);

"(C) the balance between the components of the activities undertaken pursuant to this Act;

"(D) whether the research, development and demonstration projects undertaken pursuant to this Act are—

"(i) helping to maintain United States leadership in computing and networking technologies and in the application of those technologies; and

"(ii) promoting competitive private sector markets in the provision of products and services related to these technologies and their applications;

"(E) whether the applications developed under title III are successfully addressing the needs of the targeted populations, including assessment of the number of users served by those applications; and

"(F) other issues identified by the Director.

"(2) The advisory committee established under paragraph (1) shall meet not less than once annually, following notice in the Federal Register, for the purpose of receiving oral and written public testimony on the subjects identified in subparagraphs (A) through (F) of paragraph (1). The advisory committee shall compile and submit an annual report to the Director and to the Congress containing the findings and recommendations required under this subsection and summarizing the public testimony received. In addition, the advisory committee may meet periodically as determined by its members.

"(3) The Director shall provide such support as is required to allow the advisory committee established under paragraph (1) to meet and to carry out the responsibilities assigned by this subsection.".

SEC. 5. NATIONAL RESEARCH AND EDUCATION NETWORK AMENDMENTS.

Section 102 of the High-Performance Computing Act of 1991 is amended to read as follows:

"SEC. 102. NATIONAL RESEARCH AND EDUCATION NETWORK PROGRAM.

"(a) ESTABLISHMENT.—As part of the Program described in section 101, the National Science Foundation, the Department of Defense, the Department of Energy, the Department of Commerce, the National Aeronautics and Space Administration, the Department of Education, and other agencies participating in the Program shall support the establishment of the National Research and Education Network Program. The Network Program shall consist of the following components:

"(1) Research and development of networking software and hardware required for developing high-performance data networking capabilities with the goal of achieving the transmission of data at a speed of one gigabit per second or greater.

"(2) Federal experimental test bed networks for—

"(A) developing and demonstrating advanced networking technologies resulting from the activities described in paragraph (1), including any reasonably necessary assessment of the reliability of such technologies under realistic operating conditions; and

"(B) providing connections and associated network services for purposes consistent with this Act which require levels of network capabilities not commercially available.

"(3) Provision of support for researchers, educators, and students to obtain access to and use of the Internet to allow for communication with other individuals in the research and education communities and to allow for access to high-performance computing systems, electronic information resources, other research facilities, and libraries.

"(b) TEST BED NETWORK CHARACTERISTICS.—The test bed networks shall—

"(1) be developed and deployed in coordination with the computer hardware, computer software, telecommunications, and information industries;

"(2) be designed, developed, and operated in collaboration with potential users in government, industry, and research institutions and educational institutions;

"(3) be designed, developed, and operated in a manner which fosters and maintains competition and private sector investment in high-speed data networking within the telecommunications industry;

"(4) be designed and operated in a manner which promotes and encourages research and development leading to the creation of commercial data transmission standards, enabling the establishment of privately developed high-speed commercial networks;

"(5) be designed and operated so as to ensure the application of laws that provide network and information resources security, including those that protect copyright and other intellectual property rights, and those that control access to data bases and protect national security;

"(6) have accounting mechanisms which allow users or groups of users to be charged for their usage of copyrighted materials available over the test bed networks and, where appropriate and technically feasible, for their usage of the test bed networks; and

"(7) be interoperable with Federal and non-Federal computer networks, to the extent appropriate, in a way that allows autonomy for each component network.

"(c) NETWORK ACCESS.—The Federal agencies and departments participating in activities under this section shall develop a plan with specific goals for implementing the requirements of subsection (a)(3), including provision for financial assistance to educational institutions, public libraries, and other appropriate entities. This plan shall be submitted to the Congress not later than one year after the date of enactment of the National Information Infrastructure Act of 1993. Each year thereafter, the Director shall report to Congress on progress in implementing subsection (a)(3).

"(d) RESTRICTION ON USE OF TEST BED NETWORKS.—(1) The Federal test bed networks shall not be used to provide network services that are not related to the activities under paragraphs (1) and (2) of subsection (a) and that could otherwise be provided satisfactorily using commercially available network services. Determination of satisfactory availability shall include consideration of geographic access to and affordability of service, and timeliness and technical performance standards in providing services.

"(2) The requirements of paragraph (1) shall take effect on the date set forth in the report required under paragraph (3).

"(3) Six months following the date of enactment of the National Information Infrastructure Act of 1993, the Director, after consultation with the Federal agencies and departments supporting Federal test bed networks, shall provide a report to Congress which—

"(A) describes the technical developments necessary to allow implementation of paragraph (1);

"(B) determines the earliest feasible date for implementing paragraph (1); and

"(C) sets forth that date as the date on which paragraph (1) shall take effect.

Should the Director subsequently determine that, for technical reasons, the requirements of paragraph (1) can not be imposed on that date, the Director shall, not less than 3 months prior to that date, report to Congress on the reasons for the delay in imposing the requirements of paragraph (1), and shall set forth a new date on which paragraph (1) shall take effect.

"(e) ADVANCED RESEARCH PROJECTS AGENCY RESPONSIBILITY.—As part of the Program, the Department of Defense, through the Advanced Research Projects Agency, shall support research and development of advanced fiber optics technology, switches, and protocols needed to develop the Network Program.

"(f) INFORMATION SERVICES.—The Director shall assist the President in coordinating the activities of appropriate agencies and departments to promote the development of information services that could be provided over the Internet consistent with the purposes of this Act. These services may include the provision of directories of the users and services on computer networks, data bases of unclassified Federal scientific data, training of users of data bases and computer networks, and technology to support computer-based collaboration that allows researchers and educators around the Nation to share information and instrumentation.

"(g) USE OF GRANT FUNDS.—All Federal agencies and departments are authorized to allow recipients of Federal research grants to use grant moneys to pay for computer networking expenses.

"(h) LIMITATION ON USE OF FUNDS.—Development of data communications networks pursuant to this Act shall be through purchase of standard commercial transmission and network services from vendors whenever feasible, and by contracting for customized services when such purchase is not feasible, in order to minimize Federal investment in network hardware and software.".

SEC. 6. CONFORMING AMENDMENTS.

The High-Performance Computing Act of 1991 is amended—

(1) in section 3(1)—

(A) by amending subparagraph (A) to read as follows:

"(A) accelerate progress toward a universally accessible high-capacity and high-speed data network for the Nation;"; and

(B) by striking "Network" and inserting in lieu thereof "Internet" in subparagraph (C);

(2) in section 4—

(A) by redesignating paragraphs (1), (2), (3), (4), and (5) as paragraphs (2), (7), (8), (10), and (12), respectively;

(B) by inserting before paragraph (2), as so redesignated by subparagraph (A) of this paragraph, the following new paragraph:

"(1) 'broadband' means a transmission rate for digital information on a communications network which exceeds the maximum rate possible for transmission of digital information on normal copper telephone wires;";

(C) by inserting after paragraph (2), as so redesignated by subparagraph (A) of this paragraph, the following new paragraphs:

"(3) 'disabilities' means functional limitations of hearing, vision, movement, manipulation, speech, and interpretation of information;

"(4) 'educational institutions' includes institutions of early childhood education, elementary and secondary education, postsecondary education, and vocational/technical education;

"(5) 'education at all levels' includes early childhood education, elementary and secondary education, postsecondary education, and vocational/technical education;

"(6) 'Federal test bed networks' means the Federal experimental test bed networks described in section 102(a)(2);";

(D) by inserting after paragraph (8), as so redesignated by subparagraph (A) of this paragraph, the following new paragraph:

"(9) 'Internet' means the network of both Federal and non-Federal interoperable packet switched data networks;";

(E) by amending paragraph (10), as so redesignated by subparagraph (A) of this paragraph, to read as follows:

"(10) 'Network Program' means the National Research and Education Network Program established under section 102;"; and

(F) by inserting after such paragraph (10) the following new paragraph:

"(11) 'Nondevelopmental item' has the meaning given such term in section 2325(d) of title 10, United States Code; and";

(3) in section 101(a)(2)(A) and (B), by striking "Network" and inserting in lieu thereof "Federal test bed networks";

(4) in section 101(a)(2)(C), by inserting "the private sector, States, and" after "computer networks of";

(5) in section 101(a)(4)(C), by striking "establishment of the Network" and inserting in lieu thereof "Network Program";

(6) in section 201(a)(2), by striking "Network" both places it appears and inserting in lieu thereof "Internet";

(7) in section 201(a)(3), by striking "Network" and inserting in lieu thereof "Internet for the purposes of this Act"; and

(8) in section 201(a)(4), by inserting "consistent with section 102," before "assist regional networks".

SECTION-BY-SECTION ANALYSIS
OF
H.R. 1757 AS REPORTED BY THE SUBCOMMITTEE ON SCIENCE

Section 1. Short Title.

The short title of the bill is the "National Information Infrastructure Act of 1993."

Section 2. Findings.

The bill cites the opportunities and benefits to society of developing applications of computing and networking technologies resulting from the R&D activities under the High-Performance Computing Act of 1991. The need is expressed for a coordinated, interagency program to develop such applications for the benefit of society.

Section 3. Applications of the High-Performance Computing Program.

The bill amends the High-Performance Computing (HPC) Act of 1991 by adding a new Title III having the following sections:

Section 301. Establishment of Applications Program.

The Director of the Office of Science and Technology Policy (OSTP), through the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET), is charged to establish an interagency program to develop applications of computing and networking technologies for education, libraries, health care, the provision of government information, and other appropriate fields. The program is required to focus on applications accessible and usable by all citizens, and a plan is required which establishes the goals and proposed activities under the program. The President designates the federal agencies which will participate in the applications program.

The applications program is required to involve cost sharing and partnerships among participating federal agencies, State and local governments, and the private sector. The participating federal agencies are directed to (1) give special consideration to promoting interconnected and interoperable information systems in selecting awards under the applications program, and (2) purchase items of supply available in the commercial marketplace whenever possible in carrying out activities under the Act.

Section 302. Plan for Computing and Networking Applications.

The five-year applications plan must specify program priorities and goals, agency responsibilities, and funding levels by goal and by agency. Each biennial submission of the plan to Congress must include a summary of accomplishments, an evaluation of progress and problems, and recommendations for needed congressional assistance in implementing the plan.

Section 303. Responsibilities of the FCCSET.

The FCCSET is responsible for development of the applications plan, for coordination of the applications program, and for providing OMB, prior to release of the President's budget request, with an assessment of the consistency with the plan of each participating agency's budget estimate.

Section 304. Notification Requirement.

Each agency participating in the applications program is required to identify for OMB at the time of submittal of its budget request those portions of its budget that are included in the plan or that help support the goals of the plan. OMB is required to review the agency submissions in light of the applications plan and to indicate in the President's budget request the portion of each agency's request that supports the plan.

Section 305. Network Access.

As part of the plan, the National Science Foundation (NSF) is tasked to assist, on the basis of cost sharing, educational institutions at all levels, libraries, museums, and State and local governments to interconnect and to connect to the Internet. In addition, instructional programs are authorized to train teachers, students, librarians, and local government personnel in the use of computer networks and the Internet, in particular. Finally, the OSTP Director is required to provide a report to Congress of an examination of the level of connectivity of schools, libraries, and State and local government offices to the Internet, an estimate of the cost of universal access, and recommendations for ways to expand connectivity.

A three-year authorization is provided for NSF from sums otherwise authorized: $15 million for FY 1994, $30 million for FY 1995, and $50 million for FY 1996.

Section 306. Research in Support of Applications.

The plan is required to specify research activities to address issues underlying all of the computing and networking applications being developed, including research activities in the social sciences. The plan must address research needed to provide the means to assure network security and privacy, including the management and protection of copyrighted information, and research to develop and demonstrate user-friendly network interfaces.

A five-year authorization is provided from sums otherwise authorized: $6 million for FY 1994, $15 million for FY 1995, $20 million for FY 1996, $20 million for FY 1997, and $20 million for FY 1998.

Section 307. Applications for Education.

The plan is required to specify applications for education at all levels. Activities under the plan must include: projects to demonstrate the educational uses of the Internet; development of hardware systems, software and networks for teacher training and informal education; and development of educational software.

The plan is required to include projects which address K-12 education and which strengthen ongoing educational reform activities. Authorized projects include: provision for connections among schools in local regions and for connection to the Internet, addressing the needs of both rural and urban areas; collection and dissemination of effective educational programs available via the Internet; development of undergraduate courses on educational applications of computing and networking for teachers in training; and development of educational software designed for collaborative use over the Internet.

A five-year authorization is provided for NSF from sums otherwise authorized: $16 million for FY 1994, $45 million for FY 1995, $60 million for FY 1996, $75 million for FY 1997, and $75 million for FY 1998.

Section 308. Applications for Health Care.

The plan is required to specify applications for use in the health care sector. In the area of clinical information systems, authorized projects include: test bed networks to link health providers in a variety of settings to enable sharing of medical images and records; development of technologies to manipulate and use diagnostic images and records, and basic research leading to new technologies with clinical uses, such as virtual reality; and development of database technology for better access to medical information.

To provide health information to the public, projects are authorized to: develop network and database technologies for distribution of interactive health promotion information; establish pilot programs to develop and to assess the effectiveness and cost efficiency of interactive materials to assist patients in deciding among health care options; develop user-friendly human/computer interfaces for non-specialists in computer technology; and develop technologies to provide individuals with customized health information.

Finally, projects are authorized to develop test bed networks and collaborative technology (1) to enable health and human service providers to work together in delivering coordinated care for at-risk populations, (2) to enable health care providers to obtain on-line access to health promotion and disease prevention recommendations from

Public Health Service agencies, and (3) to guide and assist clinicians in providing treatment and advice to patients and to facilitate gathering population data sets on the efficacy of treatments and on national health trends.

A five-year authorization is provided for HHS from sums otherwise authorized: $22 million for FY 1994, $54 million for FY 1995, $72 million for FY 1996, $90 million for FY 1997, and $90 million for FY 1998.

Section 309. Applications for Libraries.

The plan is required to specify projects that will allow for development of digital libraries of electronic information. Specific projects authorized include development of ways to accurately digitize, organize and store large quantities of electronic information, including development of means for identifying and protecting copyrighted material in electronic form; development of software for searching and manipulating such digital libraries; and development of user-friendly technologies, and associated training of users, for use of networked digital libraries.

Prototype digital libraries, providing public access via the Internet, are to be developed to serve as test beds for the concepts and methods authorized under this section. These prototypes are to serve as assessment tools in the utility and value of digital libraries and of the technologies available for using them. Finally, NASA is required to develop databases of software and remote-sensing images to be made available via the Internet.

A five-year authorization is provided for NSF from sums otherwise authorized: $8 million for FY 1994, $16 million for FY 1995, $22 million for FY 1996, $32 million for FY 1997, and $32 million for FY 1998. A five-year authorization is provided for NASA from sums otherwise authorized: $4 million for FY 1994, $8 million for FY 1995, $10 million for FY 1996, $12 million for FY 1997, and $12 million for FY 1998.

Section 310. Applications for Government Information.

The plan is required to specify applications to provide improved public access to information generated by federal, state and local governments. The President is required to designate a lead agency for implementing this part of the plan and for issuing policy guidelines for federal activities. Projects are authorized to connect depository libraries and other sources of government information to the Internet and to demonstrate technologies to facilitate use of government information to support research and education, economic development, and an informed citizenry. A specific requirement is included to establish an inventory/locator system for federal information accessible via the Internet.

A five-year authorization is provided from sums otherwise authorized: $4 million for FY 1994, $12 million for FY 1995, $16 million for FY 1996, $21 million for FY 1997, and $21 million for FY 1998.

Section 4. High-Performance Computing and Applications Advisory Committee.

The bill amends subsection 101(b) of the HPC Act of 1991, which establishes an advisory committee for the HPC Program. The amendment assigns the responsibility for appointing the advisory committee to the OSTP Director and broadens the scope of the committee to encompass the applications activities authorized by the new Title III. The membership of the committee is expanded to include representation from all parts of the education community, from consumer and public interest groups, and from computer hardware, computer software, telecommunications, publishing and information industries.

The advisory committee is required to meet at least annually for the purpose of receiving public testimony on the planning and implementation of the applications program and to provide an annual report to the OSTP Director and Congress on its findings and recommendations.

Section 5. National Research and Education Network Amendments.

Amendments are made to section 102 of the HPC Act of 1991, which establishes the National Research and Education Network (NREN) in order to define a revised NREN Program having three components: (1) research and development of networking software and hardware required for achieving gigabit data transmission rates, (2) experimental test bed networks to develop and demonstrate advanced networking technologies and to support applications requiring levels of network capabilities not commercially available, and (3) provision of support for researchers, educators and students to obtain access to and use of the Internet for purposes consistent with the Act. Reports to Congress are required which specify a plan for achieving the goals of component (3) defined above, and which describe annual progress toward implementation of the plan.

Use of experimental test bed networks for purposes other than those specified under (1) and (2) above is prohibited if satisfactory commercial network services are available. This prohibition becomes effective on the earliest date on which implementation is technically feasible. The OSTP Director is required to specify the date in a report to Congress.

A provision is added to require that data communications networks developed under the Act be through purchase of standard commercial services whenever feasible in order to minimize federal investment in network hardware and software.

Section 6. Conforming Amendments.

H.R.1757 As Reported by the Science Subcommittee

Authorizations by Program

$ millions

PROGRAM	FY94	FY95	FY96	FY97	FY98	TOTAL
Connections:						
NSF	15	30	50			95
Research for Applications	6	15	20	20	20	81
Education (NSF)	16	45	60	75	75	271
Health (HHS)	22	54	72	90	90	328
Libraries:						
NSF	8	16	22	32	32	110
NASA	4	8	10	12	12	46
Gov't Info	4	12	16	21	21	74
TOTAL:	75	180	250	250	250	1005

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SUMMARY OF DIFFERENCES BETWEEN H.R.1757 AS INTRODUCED AND H.R. 1757 AS REPORTED BY THE SUBCOMMITTEE ON SCIENCE

A description follows of the principal differences between H.R. 1757 as introduced and H.R. 1757 as reported by the Subcommittee on Science on June 17, 1993 (**bill section references are for the bill as introduced**):

1. The short title of the bill is changed to the "National Information Infrastructure Act of 1993".

2. Requirements to promote the development of interconnected and interoperable information systems and for federal agencies to purchase items of supply available in the commerical marketplace whenever possible are added to the provision [Sec. 301] which establishes the applications program.

3. The requirement for the OSTP Director to appoint a member of his staff as coordinator for the high performance computing and applications programs [Sec. 304] is deleted. The Administration recommended this change because a coordinator for the program has been appointed (Dr. Donald Lindberg, the Director of the National Library of Medicine) and the provision would limit the Director's flexibility in allocating his staff's responsibilities.

4. The network connections program [Sec. 306] is modified by reducing the authorization period from 5 to 3 years, specifying that the amounts authorized are from sums authorized in other statutes, and reducing the authorization level from $310 million to $95 million.

5. Authorized research activities for support of applications [Sec. 307] are expanded to include research in the social sciences and research to provide the means to manage and protect copyrighted information. The five-year authorization for this section is specified to be from sums authorized in other statutes and is reduced from $141 million to $81 million.

6. The five-year authorization for the education applications [Sec. 308] is specified to be from sums authorized in other statutes and is reduced from $364 million to $271 million.

7. Support for basic research leading to new technologies with clinical uses is added to activities authorized under applications for clinical information systems [Sec. 309(b)]. The five-year authorization for health care applications is specified to be from sums authorized in other statutes and is reduced from $364 million to $328 million.

8. Authorized activities for library applications [Sec. 310] are expanded to include the development of mechanisms for identifying and protecting copyrighted materials in

electronic form. The five-year authorization for this section is specified to be from sums authorized in other statutes and is reduced from $245 million to $152 million.

9. The requirement is added that the President designate a lead agency to implement authorized activities for applications for government information [Sec. 311] and to issue policy guidelines for relevant federal programs. The five-year authorization for this section is specified to be from sums authorized in other statutes and is reduced from $118 million to $74 million.

10. The amendment to the High Performance Computing Act (HPC) of 1991 regarding the advisory committee [Sec.4] is modified to designate the OSTP Director, rather than the President, as the appointing official for committee members and to expand representation on the committee to include the computer hardware, computer software and publishing industries. In addition, a new provision is added which requires the committee to meet at least annually to receive public testimony on the planning and implementation of the applications program and to provide a report to Congress and the OSTP Director on its findings and recommendations.

11. The amendment to the HPC Act of 1991 regarding the National Research and Education Network [Sec. 5] is modified by replacing the 18 month delay in imposing restrictions on use of federal experimental test bed networks with a date specified by the OSTP Director, which shall be the earliest date on which implementation of the restriction is technically feasible. Also regarding the restriction on use of test bed networks, factors are specified which are to be used in determining whether commercial network services are satisfactorily available. Finally, a provision is added to require that data communications networks developed under the Act be through purchase of standard commercial services whenever feasible.

12. The provision for establishing an additional associate director at OSTP for overseeing federal efforts to disseminate scientific and technical information [Sec. 6] is deleted, consistent with the recommendation of the Administration.

Mr. **Boucher**. Copies of the original bill as introduced and also the subcommittee print as reported by the Subcommittee on Science are before the members, and the written explanation of the differences in the two versions also is on the members' desks.

H.R. 1757 is now entitled, "The National Information Infrastructure Act," and it embodies the vision that was announced by President Clinton in his technology presentation in California in February for the creation of a national information highway capable of routing voice, video, and data information simultaneously and at high speed to every school, research laboratory, home, and business in the Nation.

It clearly identifies the respective role of the Federal Government on the one hand and the private sector on the other in deploying, owning, and operating the information infrastructure, and it specifies the Federal research and development support that should be provided to enable the creation of new networking technologies and near-term applications for the network.

In addressing the respective roles of the public and private sectors, H.R. 1757 makes it clear that we do not expect the Federal Government to own, manage, or deploy the information infrastructure. Those will be private sector functions. The physical network, including the fiber optic lines, the high capacity switches, and the software necessary to operate those switches, will be owned by private companies.

The Government's role, however, is also clearly defined, and that will consist of the following items:

First, the encouragement of the creation of a common set of standards and protocols, so that data will be formatted and stored in compatible manner and that it can be retrieved from any point on the network using a common set of computer commands.

The Government will provide research and development funding for a new generation of switches and software that is capable of routing information traveling at gigabit speeds ubiquitously throughout the Nation.

Also, Federal Research funding is provided for four specific areas of near-term application. These are the most obvious areas in which the high speed network will initially be used and the enumeration of this list at this time is not intended to foreclose additional research functions for new applications in the future, but initially these will be the applications for which Federal research funding is provided.

Initially, in the field of education, the expansion of electronic classrooms and distance learning, making available anywhere in the Nation the best instruction that is available at any given point; teacher training will also be provided, so that teachers will become more familiar with and comfortable with the use of computers and networking technologies and, in turn, will be capable, therefore, of training others.

And funding for direct connections to link secondary schools and 4-year and 2-year colleges to the Internet will also be provided through a program to be administered by the National Science Foundation.

The second application for which Federal funding is directed is the creation of digital libraries, so that libraries that today have material in printed form on shelves can transfer that information into electronic form and have it stored in databases which, in turn, can be accessible throughout the Nation. The goal, very simply stated, is that any person using a personal computer should be able to dial up the electronic index at any library in the Nation, browse through that index, identify a particular document, peruse that document, and then if the individual wants to do so, print it out on his or her laser printer, and do all of that within just a matter of minutes. Funding is provided to reach that very challenging goal.

The third significant application is in the field of health care delivery, and we could imagine a number of early applications within that function. The day will come before, too long, when a variety of specialists throughout the country at different locations could collaborate in making a diagnosis of a patient's disease. They could talk to each other over the voice link, watch each other over the television link, and simultaneously analyze a particular piece of data, a CAT scan or an MRI image, that is transmitted to them with the same clarity that is contained in the original image. And that degree of clarity will be very important for medical diagnosis.

Patients will be able to remain at home or potentially in some slightly more secure but still better condition than is the case today, where they often have to be in hospitals or in nursing homes simply to have their vital signs monitored. Their vital signs could be monitored by means of the network at a central monitoring facility. Patient billing and records and medical literature could be made available over the network, aiding again in health care delivery.

And the fourth function for which we anticipate early usage is the assemblage in electronic form and the availability over the network of the vast stores of government information that are often not accessible today. We provide funding for the creation of an information locator as a navigational aid and directions for the storage of government information in forms that would make it readily accessible across the network.

We also provide for the creation of a Federal test bed in which the new networking technologies created through the research program can be demonstrated. That test bed could also be used in one limited sense for the provision of direct connections for users of the network, and that would be where the users require a higher level of network performance than at that time is available from the commercial sector. For example, if super-computer sites needed a linkage that was of a higher speed and higher band width than the commercial providers made available, that higher level of performance could be provided by the Federal Government.

A very important point to make is that in all other instances we would expect the private network providers to offer the connections. So where the private provision of the service is reasonably and satisfactorily available, it would be to private provision that we would look for all connections, and the Government connections would only be in that limited range of cases where the satisfactory availability of a private connection is not possible.

We also create in the legislation a High Performance Computing and Applications Advisory Committee that will have the goal of evaluating on an ongoing basis the success of the implementation of this program and recommending to the Federal Government, both through its Executive and Legislative branches, new modifications for networking research and development that would be appropriate from time to time.

The support for this measure is universal. Private sector companies in the field of telecommunications and computers have strongly endorsed the measure, and on each member's desk is a very lengthy list, about three to four pages, of private sector participants, companies that very strongly endorse the passage of this legislation. It is also strongly endorsed by the research and education community, as evidenced by a very large number of universities and other research entities that have endorsed the measure as well.

During the course of the subcommittee's consideration we had three days of hearings, and a large number of witnesses representing the administration as well as those outside government testified. They made a large number of constructive recommendations, the great bulk of which have been accepted and appear in the subcommittee print.

Since the authorization for this program is built into the budgets of the various departments and agencies that are responsible for carrying it forward, we have made a provision in the subcommittee print that the authorization for the program will, in fact, be by separate authorization contained for those other departments and agencies. And by doing that, we avoid double authorizing for any of these programs.

H.R. 1757 specifies the research and development which should be carried out and indicates the amounts from those other general authorization bills that will be expended by the other agencies in carrying forward these purposes, and a chart that shows those expenditures has also been placed before each member.

In concluding these comments, I want to express particular appreciation to the gentleman from Pennsylvania, Mr. Walker, the gentleman from New York, Mr. Boehlert, both of whom have contributed substantially to the product that we have before us. They did so in private discussions and in the offering of recommendations, and also very actively during the course of the subcommittee markup.

It is my pleasure to recommend this measure to the full committee and urge its adoption, and I would now be pleased to recognize the gentleman from Pennsylvania.

Mr. **WALKER**. Thank you, Mr. Chairman.

I know that you, Mr. Chairman, have worked very hard with industry and educators and government agencies to craft the bill that's before us today, and I want to commend you and your staff for working so closely with our side throughout this process.

One of my biggest concerns at the outset was that in building this new computer highway, where were we going to get the billion dollars that was required for this kind of a project? So I was pleased at subcommittee that we marked up the bill in a way that supported an amendment that had this bill authorized out of existing authorizations, so that we are not going to add to the overall amounts of money that are going to be exacted from government coffers for this program, but rather will do so within the realm of the authorized programs presently out there.

At subcommittee I had an additional issue that needed to be addressed before our full committee markup. I'm heartened that together we were able to find some acceptable language, and I'll offer my amendment at the appropriate time here today.

I believe that we are on the way to building the high performance computer highway in a truly bipartisan manner, and for that, Mr. Chairman, I thank you.

Mr. BOUCHER. Thank you very much, Mr. Walker.

The gentleman from New York, Mr. Boehlert.

Mr. BOEHLERT. Mr. Chairman, I ask unanimous consent that my statement in its entirety appear in the record at this point.

Mr. BOUCHER. Without objection.

Mr. BOEHLERT. Just let me say that this is a particularly exciting moment for this committee. I think the potential that can be achieved by this legislation is limited by only one's imagination. And as Mr. Walker correctly observed, we're not adding new funds; we're taking funds from existing law, existing programs, but we're prioritizing; we're moving in the right direction. We're saying we can't do all things for all people under all circumstances. We're establishing some sensible priorities that give great promise for the future of this Nation, and I'm proud to identify with this legislation and with the spirit of bipartisanship that has been so evident in crafting it.

Thank you very much.

[The statement of Mr. Boehlert follows:]

STATEMENT OF SHERWOOD BOEHLERT

ON THE NATIONAL INFORMATION INFRASTRUCTURE ACT OF 1993

MR.CHAIRMAN. THE SUBJECT OF THIS BILL, THE INFORMATION SUPERHIGHWAY IS CRUCIAL TO THE ECONOMIC HEALTH OF THIS NATION - THE RAPID GROWTH IN INFORMATIOIN TECHNOLOGIES WILL FUEL THE ECONOMIC EXPANSION OF THIS NATION WELL INTO THE 21ST CENTURY -- JUST AS THE DEVELOPMENT OF RAILWAYS AND ROADS FUELED THE EXPANSION OF THE NATION DUING THIS CENTURY.

WE RECOGNIZED THE IMPORTANCE OF THE INFORMATION TECHNOLOGY INDUSTRY WHEN WE PASSED THE HIGH PERFORMANCE COMPUTING ACT TWO YEARS AGO. THIS LEGISLATION WILL EXPAND ON THE FOUNDATION SET BY THAT LAW -- BY IMPOVING THE DISSEMINATION OF INFORMATION BETWEEN GOVERMENT AGENCIES, SCHOOLS, HOSPITALS AND LIBRARIES -- THEREBY ALLOWING THE ALMOST ANY CITIZEN EASY ACCESS TO INFORMATION WITHIN MINUTES, AND AT THE TOUCH OF BUTTON.

MR. CHAIRMAN. I APPLAUD THE GOALS OF THIS LEGISLATION AND WANT TO ACKNOWLEGE YOUR LEADERSHIP IN DEVELOPING RATIONAL LEGISLATION TO DEAL WITH A VERY COMPLEX PROBLEM.

Mr. **Boucher**. Thank you, Mr. Boehlert.

The gentleman from North Carolina, Mr. Valentine.

Mr. **Valentine**. Mr. Chairman, I thank the Chair for recognizing me.

I support the legislation. I support the bill and ask unanimous consent to insert my prepared statement into the record.

Mr. **Boucher**. Without objection.

Mr. **Valentine**. I would like to say one thing about it, and I think this is something that—I mention this point because it is—it has nothing to do with whether or not we should pass the bill or not, but I, as an old trial lawyer, think about what the passage of this legislation might or might not do to medical malpractice lawsuits because we will have raised the standard of care to a different level in places in the United States where the communities are in a relative state of isolation. This will now, in my opinion, introduce a new element into the matter, and because that practitioner, that doctor who performs an operation will supposedly have available to him information about the latest techniques, the best that is available in the United States—so I'm sure that those who are involved in the medical malpractice trade are already focusing on what will happen when this becomes the law of the land.

I yield back the balance of my time.

[The statement of Mr. Valentine follows:]

Chairman Tim Valentine
June 30, 1993
H.R. 1757, the National Information Infrastructure Act of 1993

Mr. Chairman, I am pleased to announce my support for H.R. 1757, the National Information Infrastructure Act of 1993, a bill which will pave the way for an improved life for all Americans.

In particular, I am pleased to express my support for provisions of H.R. 1757 which would help fund high performance computing and high speed networking applications in the health care sector. The innovations included in this legislation will improve virtually every aspect of health care delivery; projects range from development of testbed networks, to electronically linking hospital facilities in remote locations to the most modern teaching hospitals, to database technology for storing, accessing, and transmitting patient records.

In this tough economic climate I am very concerned that we invest in medical technologies that have the potential to lower costs as well as increase patient access to our health care system. We must make the most of technologies that save money by cutting red tape and eliminating paperwork. However, medical technologies can also lower health care costs by permitting early diagnosis, replacing costly procedures, and reducing hospital lengths of stay.

With this in mind, at the appropriate time I will offer an amendment to Section 308, which addresses the importance of targeting limited Federal resources towards developments that have the potential of decreasing costs to the health care system.

At this point in our Nation's history, with the need to control health care costs while increasing patient access to quality medical care is foremost on our minds as policy makers, an investment in medical technology is truly an investment in America's future. Thank you, Mr. Chairman.

Mr. BOUCHER. The Chair thanks the gentleman and recognizes the gentleman from Arizona.

Mr. COPPERSMITH. Mr. Chairman, I just request unanimous consent to put a statement in the record indicating my strong support of this legislation.

Mr. BOUCHER. Without objection, that statement will appear in the record.

[The statement of Mr. Coppersmith follows:]

Honorable Sam Coppersmith

Opening Statement for Markup of H.R. 1757,
the High Performance Computing and
High Speed Networking Applications Act of 1993
(now National Information Infrastructure Act of 1993)
Committee on Science, Space, and Technology

June 30, 1993

Mr. Chairman, the information infrastructure legislation before the Committee today, H.R. 1757, will build upon the successes of the High Performance Computing Act of 1991 by making advances in computing and networking technology accessible and applicable to the American public.

The legislation will allow the National Science Foundation (NSF) to assist educational institutions, libraries, museums, and state and local governments in connecting to the global Internet network. The establishment of an information superhighway reaching Americans in myriad settings throughout the country requires development of these connections. The legislation also authorizes training programs to ensure that teachers, librarians, students, and workers who can benefit from these network connections learn how to use the networks.

I also am particularly excited about the new applications for computing technology that this legislation will help develop. Research on applications for health care information, for example, could allow health care professionals and students to share and analyze medical records and images, to simulate surgical techniques through use of virtual reality technology, and to develop interactive information usable in public health promotion efforts.

Thanks in part to the successes of the High Performance Computing Act of 1991, we already have developed some of the advanced technologies needed for many such applications. The Computer Assisted Design Group headed by Dr. Robert Barnhill of Arizona State University, for example, already is making tremendous advances in the kinds of visualization software which may prove useful for analyzing medical images. The proposed legislation will help make possible the research necessary to translate those advances into actual applications. I look forward to the possible participation of ASU in those efforts.

Mr. Chairman, I strongly support the initiatives in the bill before us, which will be funded from funds authorized in other statutes and will require cost-sharing. I urge my colleagues to support the legislation.

Mr. BOUCHER. Do other members seek recognition for purposes of an opening statement?

[The prepared opening statement of Mr. Grams follows:]

ROD GRAMS
6TH DISTRICT, MINNESOTA

COMMITTEE ON BANKING,
FINANCE AND URBAN AFFAIRS

SUBCOMMITTEES
HOUSING AND COMMUNITY DEVELOPMENT
FINANCIAL INSTITUTIONS SUPERVISION,
REGULATION AND INSURANCE
CONSUMER CREDIT AND INSURANCE

COMMITTEE ON SCIENCE,
SPACE AND TECHNOLOGY

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House of Representatives
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STATEMENT OF THE HONORABLE ROD GRAMS

BEFORE THE HOUSE SCIENCE SPACE AND TECHNOLOGY COMMITTEE
DURING FULL COMMITTEE CONSIDERATION OF
H.R. 1757, THE NATIONAL INFORMATION INFRASTRUCTURE ACT OF 1993

MR. CHAIRMAN, I WANT TO TAKE JUST A MOMENT TO COMMEND THE AUTHORS OF THIS LEGISLATION, MR. BOUCHER, CHAIRMAN OF THE SCIENCE SUBCOMMITTEE, AND MR. BOEHLERT, RANKING MEMBER OF THE SUBCOMMITTEE. THEY EXIBITED TRUE BIPARTISAN LEADERSHIP IN CRAFTING THIS LEGISLATION BEFORE US TODAY.

H.R. 1757, THE NATIONAL INFORMATION INFRASTRUCTURE ACT OF 1993, PROTECTS AND REAFFIRMS PRIVATE SECTOR COPYRIGHT AND INTELLECTUAL PROPERTY PROTECTIONS AS WE MOVE INTO THE 21ST CENTURY FRONTIER OF DIGITAL INFORMATION.

THESE PROTECTIONS, INCLUDING THE LANGUAGE REGARDING DIGITAL LIBRARIES ADDED BY MY COLLEAGUE FROM MINNESOTA, MR. MINGE, WILL GIVE INFORMATION PROVIDERS THE CONFIDENCE NEEDED TO SEND THEIR PRODUCTS ACROSS THIS NEW INFORMATION HIGHWAY.

I LOOK FORWARD TO WORKING WITH THE AUTHORS OF H.R. 1757, AND MY COLLEAGUES ON THIS COMMITTEE IN EXPEDITING CONSIDERATION OF THIS LEGISLATION FOR THE BENEFIT OF ALL AMERICANS

THANK YOU.

Mr. **BOUCHER**. The Chair will now entertain amendments and would recognize first the gentleman from North Carolina.

Mr. **VALENTINE**. Mr. Chairman, I have an amendment which I believe has been circulated.

Mr. **BOUCHER**. The Clerk will report the amendment.

The **CLERK**. "Amendment to H.R. 1757 offered by Mr. Valentine.

"Page 16, line 17, insert ', with the goal of improving the quality and enhancing the cost-effectiveness of health care. Special consideration shall be given to applications that are designed to lower health care costs' after the phrase 'health care sector'."

[The information follows:]

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AMENDMENT TO H.R. 1757

OFFERED BY MR. VALENTINE

Page 16, line 17, insert ", with the goal of improving the quality and enhancing the cost-effectiveness of health care. Special consideration shall be given to applications that are designed to lower health care costs" after "health care sector".

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June 28, 1993

Mr. **BOUCHER**. The gentleman is recognized.

Mr. **VALENTINE**. Mr. Chairman and members of the committee, the National Information Infrastructure Act of 1993 points to the need for good research in medical applications for high performance computing, but with compelling budget concerns, particularly over health care costs, one criterion of the research should be improving the cost efficiency of medical care in the United States.

This amendment is intended to make sure that those who decide which medical applications receive funding under this program, that they give due consideration to medical applications that will contribute to the health care system in ways that will reduce expenses.

I commend the amendment. I think that it—I'm happy to be here with an amendment that doesn't cost anything but will provide a means of saving money.

Mr. **BOUCHER**. Will the gentleman yield?

Mr. **VALENTINE**. I yield to the chairman.

Mr. **BOUCHER**. I thank the gentleman for yielding and I'm pleased to endorse his amendment and urge that it be adopted as very much in conformance with the goals of the health care applications and helpful to those.

Mr. **VALENTINE**. I thank the Chair.

Mr. **WALKER**. Would the gentleman yield? Will the gentleman yield?

Mr. **VALENTINE**. I yield.

Mr. **WALKER**. In line with his previous comments, I'm wondering whether or not he might want to put some language in after the word "cost" that says "including liability and malpractice cost." [Laughter.]

Mr. **VALENTINE**. No, no, I don't want to get into that. That was a thought that occurred to me that I just thought I would float that out——

Mr. **WALKER**. I thank the gentleman.

Mr. **VALENTINE** [continuing]. So that that could be—you know, with progress in one area, there becomes progress in other areas. So as we make progress in the advancement of medical science, we will also test the ingenuity of America's trial lawyers. [Laughter.]

Mr. **BOUCHER**. Is there further discussion on the amendment offered by the gentleman from North Carolina?

[No response.]

If not, the question occurs on the amendment. Those in favor will say aye.

Those opposed, no.

The ayes have it, and the amendment is agreed to.

The gentleman from Pennsylvania is recognized for purposes of offering an amendment.

Mr. **WALKER**. Mr. Chairman, I have an amendment which is before the members which will clarify that it is our intent——

Mr. **BOUCHER**. The Clerk will report the amendment.

The **CLERK**. "Amendment offered by Mr. Walker to the amendment in the nature of a substitute"——

Mr. WALKER. I ask unanimous consent that the amendment be considered as read.

Mr. BOUCHER. Without objection.

[The information follows:]

②

AMENDMENT OFFERED BY MR. WALKER TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 1757

Page 34, after line 11, insert the following new section:

SEC. 6. COMPETITIVE PROCUREMENTS.

Title II of the High-Performance Computing Act of 1991 is amended by adding at the end the following new section:

"SEC. 209. COMPETITIVE PROCUREMENTS.

"The Competition in Contracting Act shall apply to all procurements under this Act of $25,000 or greater."

Page 34, line 12, redesignate section 6 as section 7.

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June 28, 1993

Mr. BOUCHER. The gentleman is recognized.

Mr. WALKER. This amendment will clarify that it is our intent that the procurements and awards of the High Performance Computing Act will be made on a competitive basis. Since 1984, the Competition in Contracting Act, or CICA, has been required—has required that the procurement of goods and services be full and open to competition. My amendment would simply codify this understanding.

No one should have an objection to the requirement calling for competition. This amendment establishes a threshold of $25,000 before the Competition Act applies. This is in keeping with the small purchase procedures that agencies currently operate under. This amendment has been shared with the majority, and I understand there is no opposition to it, and I urge its adoption.

Mr. BOUCHER. Would the gentleman yield?

Mr. WALKER. I'd be happy to yield.

Mr. BOUCHER. I thank the gentleman for yielding and concur in the gentleman's comments, and would urge the adoption of his amendment.

Is there further discussion on the amendment offered by the gentleman from Pennsylvania?

[No response.]

If not, the question is on the amendment. Those in favor will say aye.

Those opposed, no.

The ayes have it, and the amendment is agreed to.

The Chair now recognizes the gentleman from Texas, Mr. Johnson, for purposes of offering an amendment.

Mr. JOHNSON of Texas. Thank you, Mr. Chairman. I have an amendment. Can we consider it as read?

Mr. BOUCHER. The clerk will report the amendment.

The CLERK. "Amendment to H.R. 1757"——

Mr. JOHNSON of Texas. I make a request——

Mr. BOUCHER. Without objection, the amendment will be considered as read.

[The information follows:]

③

AMENDMENT TO H.R. 1757

OFFERED BY MR. SAM JOHNSON OF TEXAS

Page 37, line 23, strike "and".

Page 38, line 3, strike the period and insert in lieu thereof a semicolon.

Page 38, after line 3, insert the following new paragraphs:

(9) in section 202(b), by striking "$134,000,000" and inserting in lieu thereof "$111,000,000"; and

(10) in section 203(e)(1), by striking "$138,000,000" and inserting in lieu thereof "$124,000,000".

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Mr. JOHNSON of Texas. Thank you, Mr. Chairman.

Mr. BOUCHER. The gentleman is recognized.

Mr. JOHNSON of Texas. I just want to commend you also for this proposal. I believe that in view of Mr. Valentine's comments that some of those medical procedures are already being proposed and taking place, and I think it's a marvelous innovation in our society and I hope, with you, that it can reduce some of our medical costs.

This amendment is a simple, straightforward amendment which saves the taxpayers just $37 million. There are two agencies that are funded out of the aid above the President's request, NASA and the Department of Energy, and this amendment simply brings the two agencies in line with the President's request. And I think it's a fair amendment and doesn't jeopardize the effectiveness of either program and reduces the funding level to the President's request, and I ask for approval. And, as I understand it, Mr. Brown has given his approval to this amendment as well. I thank you for that.

Mr. BOUCHER. Would the gentleman yield?

I thank the gentleman for yielding and commend him on offering this amendment, and I'm also pleased to urge its adoption.

It would peg the authorization levels at the level of the administration's request for funding for this variety of programs among the agencies that will carry it out, and, as a practical matter, that is a perfectly adequate funding level to accomplish the goals that we have set forth.

The gentleman is correct in pointing out that it will save money and I think he does us a service by offering that amendment which I'm pleased to endorse.

Mr. JOHNSON of Texas. Well, I'd like to thank you as well for working with everyone to make sure that business is comfortable with the arrangement, and I thank you for doing that.

Mr. BOUCHER. Is there further discussion on the amendment offered by the gentleman from Texas?

[No response.]

If not, the question is on the amendment. Those in favor will say aye.

Those opposed, no.

The ayes have it, and the amendment is agreed to.

The Chair now recognizes the gentleman from Minnesota, Mr. Grams, for purposes of offering an amendment.

Mr. GRAMS. Thank you, Mr. Chairman. I have an amendment before the members.

Mr. BOUCHER. The clerk will report the amendment.

Mr. GRAMS. I move that it be approved as read.

Mr. BOUCHER. The consent request is approved.

[The information follows:]

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AMENDMENT TO H.R. 1757

OFFERED BY MR. GRAMS

Page 38, after line 3, insert the following new section:

SEC. 7. SUNSET.

(a) IN GENERAL.—Except as provided in subsection (b), the provisions of this Act, and the amendments made by this Act, shall expire on October 1, 1998.

(b) EXCEPTION.—Section 305 of the High-Performance Computing Act of 1991, as added by section 3 of this Act, shall expire on October 1, 1996.

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June 28, 1993 (11:00 a.m.)

Mr. BOUCHER. Without objection, the gentleman is recognized.

Mr. GRAMS. Thank you, Mr. Chairman.

My amendment, again, is another sunset amendment tailored to mirror the length of authorizations under this bill. While the majority of the bill is authorized through fiscal year 1998, section 305 authorizes the network access portion through fiscal year 1996. Therefore, this amendment sunsets the act and its amendments made by this act at the end of fiscal year 1998, except for section 305, which is sunset at the end of fiscal year 1996.

Again, I think this is to keep the control and the authorization before this committee and not before the appropriators.

Mr. BOUCHER. The Chair thanks the gentleman and would announce that the Chair has a substitute amendment to offer to the gentleman's amendment, and would ask that the clerk report that substitute.

The CLERK. "Substitute to the amendment offered by Mr. Grams to H.R. 1757 offered by Mr. Boucher.

"Page 38, after line 3, insert the following new section:

"SECTION 7. SUNSET.

"(a) IN GENERAL.—Except as provided in subsection (b), no funds are authorized to be appropriated for any fiscal year after fiscal year 1998 for carrying out the programs for which funds are authorized by this act, or the amendments made by this act.

"(b) EXCEPTION.—No funds are authorized to be appropriated for any Fiscal Year after Fiscal Year 1996 for carrying out section 305 of the High Performance Computing Act of 1991, as added by section 3 of this act.".

[The information follows:]

SUBSTITUTE TO THE AMENDMENT OFFERED BY MR. GRAMS TO H.R. 1757

Offered by Mr. Boucher

Page 38, after line 3, insert the following new section:

Sec. 7 SUNSET.

(a) In General --Except as provided in subsection (b), no funds are authorized to be appropriated for any fiscal year after fiscal year 1998 for carrying out the programs for which funds are authorized by this Act, or the amendments made by this Act.

(b) Exception. -- No funds are authorized to be appropriated for any fiscal year after fiscal year 1996 for carrying out Section 305 of the High-Performance Computing Act of 1991, as added by section 3 of this Act.

Mr. BOUCHER. Yes, thank you very much.

I would take just a moment to point out that some genuine potential for difficulty could arise if the substitute is not agreed to, in that we all agree that there ought to be reauthorization on a periodic basis for programs, but what could well happen in the event that there is some delay in that reauthorization for scheduling or other reasons is that a great deal of confusion could result in the implementation and administration of the program.

What the amendment does, what the substitute would do is provide for continuity in the event that there was some delay in the authorization for the program on an ongoing basis, and that continuity, I would argue, is very much necessary.

We agree with the principle that the gentleman from Minnesota puts forth, that there ought to be a sunset of the program at the end of the authorization period. The continuity between the first authorization and subsequent authorizations is also necessary, and our substitute would provide for that continuity.

I would hope the gentleman would find that acceptable, and I would be pleased at this time to ask if there are other members who seek recognition on this question.

The gentleman from Pennsylvania, Mr. Walker.

Mr. WALKER. Well, I will seek recognition primarily, first of all, to yield to Mr. Grams to see what his view of the substitute is.

Mr. GRAMS. All right, thank you, Mr. Chairman.

Well, I would respectfully oppose this amendment because, my understanding of this amendment, it would allow the program to continue and it would allow it to go with the supervision of the Federal—under the supervision of the Federal Government. So it would keep the Federal Government involved beyond the date of the bill itself of 1998 or the other act of 1996.

It's my understanding that this bill is a 5-year program, that it is set up to complete its goal within the 5 years, and it is not intended to go on for years and years after that. So this would sunset the Federal involvement and the program at the end of 5 years and put it, if it's going to continue, into the private sector. So I don't see anything wrong with it coming back to the committee after that 5-year period of time to have it reassessed and to say if it should remain in the hands of the Federal Government.

According to what I understand in the bill, that is not the intent, that this is a program with a definite time in mind and that is 5 years for 1 and 3 years for the other part of the act, and my sunset would abide by those time tables set up and not allow a loophole for the program to continue or to limp along or for the Government to have remain involved in this.

Mr. WALKER. I thank you for your explanation, and I must admit that I'm a little confused by the nuances here, too, but let me describe it the way I think what the differences between the two bills are and why Mr. Grams may be right in this case about not accepting the substitute.

When we're—as we're setting up this program, our intent is to have a 5-year program. I mean, this is supposed to be a 5-year program in which to demonstrate this technology. It will lead to the high performance computing network.

Under the substitute that's offered, that program could go on after the 5-year period. All the substitute says is that no funds can go to the program, but the fact is that if there were previously authorized funds, they could continue to be spent out for some period of time, and we would not be able to actually terminate the program. The program would continue to exist.

Under Mr. Grams' sunset provision, the program would be terminated after the 5 years, that there would be no program left; there would be no way to go ahead, to go on spending money after the 5-year period. And so there is a difference here. He totally terminates the program. The sunset provision offered in the substitute would allow the program to stay in place, but simply would cut off the money for it at that point, but previously authorized money or previously appropriated monies could continue to be spent out in long-term contracts.

And so that's the nuance difference here, but it's a fairly important nuance if you think that the idea behind sunset is to shut things down or to simply shut off money. In Mr. Grams' case here, he believes it's time to shut things down after the 5 years that we've allocated for the program. I tend to agree with Mr. Grams.

Mr. BOUCHER. Would the gentleman yield to me on that point?

Mr. WALKER. I'd be happy to yield to the chairman.

Mr. BOUCHER. I want to directly address what the gentleman was raising. The difficulty is a very practical one, and that is that if the gentleman from California—the gentleman from Minnesota's position prevails, as opposed to that in the substitute, if for some reason the programs are not reauthorized in a scheduled and timely way, the authority of agencies to enforce existing contracts and to honor existing obligations would expire as well. And it is simply not appropriate to my way of thinking to create that potential for confusion and that degree of uncertainty.

In either event, under the gentleman's approach or the one that I have proposed, the Appropriations Committees would be disabled from making any additional appropriations. So if the concern is to have additional funding for the programs continue, that would not happen in either event.

What we would do, however, is provide for continuity in terms of enabling projects that were already in the works to be carried forward, existing contracts to be carried forward, and for the agencies to perform their obligations under those contracts, and for money that was already in the pipeline and had been appropriated and was being put forward in collaborative arrangements and the like to be expended.

In the event that the gentleman from Minnesota's position prevails, all of those authorities would come to a halt, and the potential for that to happen might even tend to chill the willingness of some private sector participants or maybe even universities to participate in the programs in the final years if it doesn't appear totally certain and absolutely certain that reauthorization is going to occur in a timely way.

I certainly agree that we ought to have reauthorization in a timely fashion, but, as the gentleman knows, that doesn't always occur, and the agencies should be empowered to continue forward in their work in the event that for scheduling or other reasons it doesn't.

Mr. **WALKER**. Well, Mr. Chairman, I think that's where we're running into somewhat of perception problem here. Our feeling was that the bill is designed as a 5-year program and is supposed to accomplish its ends in 5 years.

Now if the intention here is to go beyond five years and come back and reauthorize the programs and keep them going, that's something different from what the understanding was on the program. And, in all honesty, this business of not sunsetting them, but leaving them open to further authorization and appropriation is one of the things that has led to real problems.

We were told, for instance, that under the Hollings centers that they were going to be spun off after a period of years and that the private sector is going to pick them up. In most recent iterations of those, we have now found out that having gotten their largesse of Government money, they want to keep the money flowing to them. And so our ability to cut off that Government money has become very difficult.

We find it in all kinds of programs, that the appropriations continue even after the authorization ceases to exist because it is assumed that because they are there they deserve to continue to get money, and I think that what Mr. Grams is saying is the only way to shut down a program is to shut down a program, and that if, in fact, everybody understands the ground rules from the outset, that at the end of the 5-year period there is going to be no more Federal program, that whatever has been accomplished is then going to have been accomplished and we are going to move on from there, that his amendment then should prevail, if you end it when you end it. You don't end it with the idea that it might be picked up again at some future point, and I think that that is a real element of difference between the two approaches that we have before us.

Mr. **BOUCHER**. Would the gentleman yield to me again?

Mr. **WALKER**. Sure.

Mr. **BOUCHER**. We, obviously, could stand a bit more time to look at this. And what I would like to propose to the gentleman is this, and propose it also to the gentleman from Minnesota: that between the time that this bill is reported from committee and we take this measure to the floor, that we work with the gentleman from Minnesota and the gentleman from Pennsylvania to try to reach agreements on language that would serve the purposes that I think all of us endorse, and that is the full effectiveness of this program within a 5-year period, and would not have the effect of implying or directly providing in some way the suggestion of continuing authorization beyond that time, but leave the agencies free to do their work and to fully carry forward this program within the 5-year period.

If the gentleman from Minnesota would agree to withdraw his amendment, we will pledge our efforts to work with him to achieve those results.

Mr. **WALKER**. Well, let me just clarify one point. The chairman, before he left for his other meeting, he indicated that the intention was to bring these up under suspension of the rules. That would leave us with some difficulty if we do not have language in the bill on this subject matter that could then be worked out before the bill is brought up on a suspension calendar.

Mr. BOUCHER. Would the gentleman yield to me?

Mr. WALKER. Sure, I'd be happy to yield to the chairman.

Mr. BOUCHER. Well, of course, when we suspend the rules, we suspend the rules and whatever is in the text of the bill then is passed, assuming that two-thirds of the members vote for it. And our intention would be to recraft the text to be presented to the membership of the full House to reflect whatever agreement we achieve in the interim period.

Mr. WALKER. Well, I don't have a problem with that; I can't speak, again, for Mr. Grams, whether or not that is acceptable solution, either——

Mr. BOUCHER. The gentleman from Minnesota.

Mr. WALKER [continuing]. Just to try to work out something that would be more in line with him.

Mr. GRAMS. I could possibly accept it, but, you know, the terms are still that, as Mr. Walker had mentioned, that this program is designed to be a 5-year program. If you're going to buy house or a construct a house, if it's supposed to be done by the 1st of September, you expect that to be completed. You don't give your contractor authorization to continue the program on for months and months or years, and you might have to come back and reauthorize more money.

I think this program has got a goal in mind. We have a 5-year time limit on it. We expect the job to be completed in 5 years. Then it's up to this committee to come back, and I expect this committee to act responsibly and quickly. If they say the goal has been reached and we would like to expand the scope, and then reauthorize more money, but not to continue this program.

So my intent on this is to follow through on this program, to find a completion date, which is 5 years. Then if the program is viable, I think the committee will responsibly come back and reauthorize more money to complete it. Otherwise, I would like to see this amendment looked at in that perspective.

Mr. BOUCHER. The Chair would ask the gentleman from Minnesota if he is expressing agreement to work with us in the time between now and the time that this measure is taken up on the floor, and if he will agree to that, would ask that the gentleman request unanimous consent that his amendment be withdrawn.

Mr. GRAMS. If I can—just a second; let me check.

Mr. Chairman? Mr. Chairman?

Mr. BOUCHER. The gentleman from Minnesota.

Mr. GRAMS. I would just like to guarantee that we will have the opportunity to present this again for consideration.

Mr. BOUCHER. Well, what I'm offering to the gentleman is an opportunity to work with him on achieving language that, hopefully, would meet our common purposes. If the gentleman prefers, we will vote on the amendment today, but the Chair will oppose it in the event that that is the gentleman's desire.

Mr. GRAMS. OK, we could—would love to have the pleasure to work with you——

Mr. BOUCHER. All right.

Mr. GRAMS [continuing]. In trying to work out some language. [Laughter.]

Mr. BOUCHER. The gentleman asks unanimous consent that the amendment be withdrawn. Is there objection?

[No response.]

The Chair hears none.

Are there other members seeking recognition for purposes of offering an amendment?

Mr. VALENTINE. Mr. Chairman.

Mr. VOLKMER. Your substitute?

Mr. BOUCHER. Yes, the Chair asks unanimous consent that the substitute to the gentleman from Minnesota's amendment be withdrawn. And without objection, so ordered.

The gentleman from Minnesota asks unanimous consent that his amendment be withdrawn. Without objection, so ordered.

Are there other members seeking recognition for purposes of offering an amendment?

The gentleman from North Carolina.

Mr. VALENTINE. Mr. Chairman, our colleague, Mr. Traficant, had to be at another place, and before he departed, he anointed me to offer his amendment, which I do herewith.

Mr. BOUCHER. The Clerk will report the amendment.

The CLERK. "Amendment to H.R. 1757 offered by Mr. Traficant."

Mr. VALENTINE. Mr. Chairman, I ask unanimous consent that the amendment be considered as read.

Mr. BOUCHER. Without objection.

[The information follows:]

⑤

AMENDMENT TO H.R. 1757
OFFERED BY MR. TRAFICANT

Page 38, after line 3, insert the following new section:

SEC. 7. USE OF DOMESTIC PRODUCTS.

(a) PROHIBITION AGAINST FRAUDULENT USE OF "MADE IN AMERICA" LABELS.—(1) A person shall not intentionally affix a label bearing the inscription of "Made in America", or any inscription with that meaning, to any product sold in or shipped to the United States, if that product is not a domestic product.

(2) A person who violates paragraph (1) shall not be eligible for any contract for a procurement carried out with amounts authorized under this Act, or under any amendment made by this Act, including any subcontract under such a contract pursuant to the debarment, suspension, and ineligibility procedures in subpart 9.4 of chapter 1 of title 48, Code of Federal Regulations, or any successor procedures thereto.

(b) COMPLIANCE WITH BUY AMERICAN ACT.—(1) Except as provided in paragraph (2), the head of each agency which conducts procurements shall ensure that such procurements are conducted in compliance with sections 2 through 4 of the Act of March 3, 1933 (41 U.S.C.

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10a through 10c, popularly known as the "Buy American Act").

(2) This subsection shall apply only to procurements made for which—

(A) amounts are authorized by this Act, or by any amendment made by this Act, to be made available; and

(B) solicitations for bids are issued after the date of enactment of this Act.

(3) The Director of the Office of Science and Technology Policy, before January 1, 1995, shall report to the Congress on procurements covered under this subsection of products that are not domestic products.

(c) DEFINITION.—For the purposes of this section, the term "domestic product" means a product—

(1) that is manufactured or produced in the United States; and

(2) at least 50 percent of the cost of the articles, materials, or supplies of which are mined, produced, or manufactured in the United States.

(d) PURCHASE OF AMERICAN MADE EQUIPMENT AND PRODUCTS.—

(1) SENSE OF CONGRESS.—It is the sense of Congress that any recipient of a grant under this Act, or under any amendment made by this Act,

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should purchase, when available and cost-effective, American made equipment and products when expending grant monies.

(2) NOTICE TO RECIPIENTS OF ASSISTANCE.—In allocating grants under this Act, or under any amendment made by this Act, the appropriate agency or department shall provide to each recipient a notice describing the statement made in paragraph (1) by the Congress.

Mr. BOUCHER. And the gentleman is recognized.

Mr. VALENTINE. Mr. Chairman, my colleagues, this is the standard Traficant amendment which, as I looked at it, I think it has been improved, improved through the years, and so we get the best of both worlds. We get to vote on it without having to hear his arguments. [Laughter.]

Mr. BOUCHER. Is there further——

Mr. VALENTINE. I yield back the balance of my time.

Mr. BOUCHER. Is there further discussion on the amendment offered by the gentleman from North Carolina?

The gentleman from Pennsylvania.

Mr. WALKER. Mr. Chairman, this, as I understand it, is the same exact language that we've adopted before that has a lot of safeguards in it that says that we really don't have to do what the amendment says, but I do want to raise one point of caution, when we're going into these very high technology areas and we're developing a new system here.

The fact is in a global economy there may be things in that worldwide economy that we might want to use as a part of a high performance computing network. When we start talking about precluding any of those goods from coming into the network, we are probably undermining our own ability to do some of the real work that we want to have it—that achieves good things for the country. And so this is not as—this is not as innocuous an amendment, given where we are headed with this bill, as it sometimes is with other kinds of measures that we're passing.

And I just raise a note of caution that while this language probably is not going to do any particular harm, that to go beyond this language and adopt this attitude about the high performance computing network would be, I think, extremely harmful to us in the long term of developing a network that has the whole aura of global competition encompassed within it.

And I don't have any objections to the amendment here, but I would hope we would give some thought to the nature of what we're doing here and its potential impact on our ability to do the kind of science that we really want done in high performance computing.

Mr. BOUCHER. Would the gentleman yield to me?

Mr. WALKER. Sure.

Mr. BOUCHER. I share many of the gentleman's concerns, and we have looked at the Traficant amendment-Valentine amendment very carefully with those concerns in mind. It really doesn't go beyond existing law in terms of what is required, in terms of Buy America provisions. It also is couched in terms of the reasonable availability of the products that are necessary from domestic sources, giving leeway to purchase from foreign sources in the event that that availability is not assured.

And while I think the gentleman very correctly points out the need that will obviously exist in many cases to rely on foreign sources for these items, I'm comfortable in reporting that this amendment provides the leeway to do that.

Mr. WALKER. I thank the chairman.

My main concern is that we have had a couple of amendments added on the floor in recent months to other pieces of legislation that basically build upon the Traficant language and went well beyond that, that literally begin to shut us out of global markets in terms of dealing in these areas, and that's where I have my real concern.

Thank you, Mr. Chairman.

Mr. BOUCHER. The gentleman from California.

Mr. ROHRABACHER. Yes, Mr. Chairman, another part of this whole equation of Buy American—and I generally think Mr. Traficant is on target; you know, if we're going to buy a certain number of cars and there's an American tire company that can sell the tires, well, let's try to give the business to the Americans. I mean, that makes sense to me.

But when we're talking about high technology, let us note that we have companies that are trying to sell high technology systems overseas as well, and for us to say we're going to set up a major communications and electronics system in the United States and we're sending the signal to people overseas that we are only going to use American products if we can get away with it, the fact is those other countries are going to be setting up their systems and they're going to faced with choices of buying American products or not, and we could well be giving an excuse to foreign nations not to buy America's electronic products if we have this same type of restriction placed on our decisionmaking. And I think it's a very bad precedent and could cost America megadollars.

Mr. BOUCHER. Is there further discussion of the amendment offered by the gentleman from North Carolina?

[No response.]

If not, the question is on the amendment. Those in favor will say aye.

Those opposed, no.

In the opinion of the Chair, the ayes have it. The ayes have it, and the amendment is agreed to.

Are there other members who seek recognition for purposes of offering an amendment?

[No response.]

The Chair recognizes the gentleman from Pennsylvania.

Mr. WALKER. Mr. Chairman, I move the committee report the bill, H.R. 1757, with an amendment and instruct the staff to prepare the legislative report and make technical and conforming amendments, and that the chairman take all steps to bring the bill before the House for consideration.

Mr. BOUCHER. Is there discussion on the motion?

[No response.]

If not, the question is on the motion of the gentleman from Pennsylvania. Those in favor will say aye.

Those opposed, no.

The ayes appear to have it. The ayes have it, and the bill is reported in accordance with the gentleman's instructions.

There being no further business to come before this committee, this session is adjourned, subject to the call of the Chair.

[Whereupon, at 12:18 p.m., the committee adjourned subject to the call of the Chair.]

Testimony of

Roberta Balstad Miller, Ph.D.
President and Chief Executive Officer
Consortium for International Earth Science Information Network
(CIESIN)

before the

Committee on Science, Space, and Technology
Subcommittee on Science

Hearings on H.R. 1757

11 May 1993

Mr. Chairman, thank you for this opportunity to present testimony on the High Performance Computing and High Speed Networking Applications Act of 1993, H.R. 1757. My name is Roberta Balstad Miller, I am a scientist and the Chief Executive Officer of the Consortium for International Earth Science Information Network (CIESIN, pronounced "season").

CIESIN is a national, non-profit research and applications consortium of six universities and a research institute, including the University of Michigan, Michigan State University, the University of Maryland at College Park, Polytechnic University of New York, Saginaw Valley State University, Utah State University, and the Environmental Research Institute of Michigan. In addition, CIESIN works closely with the National Center for Geographic Information & Analysis at the University of California at Santa Barbara (UCSB). UCSB is represented by an At-Large Member of our Board of Trustees.

CIESIN was formed in 1989 to respond to Public Law 101-144, which directed a study of the current and planned programs for government-wide Earth monitoring systems. CIESIN is an agency-neutral program that specializes in the access and integration of Earth and human science information across agency missions and scientific disciplines. CIESIN is privileged to be fulfilling this congressional directive through the continued support and vision of our National Aeronautics & Space Administration, the US Environmental Protection Agency, the US Department of Agriculture, the Department of Defense, and the Office of Science & Technology Policy.

I am particularly pleased to describe for the Committee the activities of my organization which was founded to extend U.S. leadership in a specialized high-performance computing and communication application. The CIESIN initiative was created by Congress in 1989 to exploit advanced distributed-network technologies that enable the linking of diverse data and information sources into a single, transparent, "digital library."

It is my purpose here today to comment on H.R. 1757 in light of CIESIN's efforts. We are proud of CIESIN's achievements and are grateful for the opportunity to share our experience in confronting several vexing information management and research productivity problems. We believe the principal project activities which CIESIN is executing today, are meritorious examples of the applications which H.R. 1757 seeks to foster and promote.

The following provides CIESIN's views on H.R. 1757 section by section, and provides relevant examples of CIESIN's work in the cited areas. We hope that our experience will assist the committee in broadening support for this enormously important legislation. We are also pleased to respectfully offer several recommendations on how the bill might be strengthened, based upon our initial findings as an information networking initiative.

The CIESIN Initiative

The CIESIN initiative is, by any reasoned definition, a high performance computing and high speed networking application to make global change science information accessible and useful in the service of scientists, policy makers, applied users, the educational community, and the public. The Congress and the Executive Branch tasked the CIESIN organization to demonstrate how a high performance computing and associated telecommunications networks could be used to electronically link Earth and human science data and information resources and make it more accessible and useful.

Objectives of the CIESIN initiative are to solve the challenges posed by sharing heterogeneous scientific data and information; enabling access and use of data and information by a diverse community of potential users; and promoting the understanding of integrated global change information. Our objectives are to make this data seamlessly accessible from a user friendly directory, and to make the high level of complexity in advanced computer and telecommunications transparent to the user. The international earth science network which my organization is building is dedicated to promoting a greater understanding and a broader consensus on one of the greatest challenges of modern times: understanding the impact of humankind on our global habitat.

I am pleased to report to the Committee, that after more than three years of work, the consortium has made substantial progress in realizing the objectives of its congressional mandate. I believe that our experience strongly endorses and validates the purpose and goals of H.R. 1757. Further, I submit that the CIESIN initiative is today developing several of the key applications which H.R. 1757 articulates. We believe these developments are deserving of the support of the Committee. H.R. 1757 should institutionalize the congressional CIESIN initiative as a consistent and supporting program within the framework of this watershed legislation.

CIESIN Applications in Action

The House Committee on Science and Technology was one of the first to identify the national importance of developing a high-speed computing and communications network. The work of the Committee culminated in the enactment of the High Performance Computing Program and the National Research and Education Network in 1991. The Committee is to be commended for its leadership in recognizing and acting upon the potential of advanced computing and telecommunications technologies which are critical to the continued economic preeminence of our Nation.

The "National Challenges" to be addressed in the High Performance Computing and Communications Program promise to serve the national economy, national security, education, and the global environment. However, it has now become evident that technology and networking advances from this Program can and should be combined with applications to address critical national problems. Then Sen. Albert Gore, Jr. summed this up quite well:

> *"All [telecommunications companies] are regulated by vague, outdated, conflicting, constantly changing government telecommunications policies. The result is that the private sector hesitates to jump in and make the investment. We face the classic 'chicken and egg' dilemma. Because there is no network, there is no apparent demand for the network; because there is no demand, there is no network."*
>
> Scientific American,
> September 1991, p 153.

By creating applications, or embracing those underway through initiatives such as CIESIN, we can more productively and economically address important national concerns, and our country can immediately apply the fruits of the network in the service of the national economy, national security, education and the global environment.

H.R. 1757 is a tribute to the foresight and leadership of the Chairmen Boucher, Brown, and Valentine, the other 16 original cosponsors of the bill, and the Committee on Science, Space, and Technology. This bill would establish an interagency applications program to be coordinated by the White

House across the federal agencies. The applications are designed to be accessible and usable by all persons in the United States, in the fields of education, libraries, health care, and other fields.

The area of "global environment," is a featured component of the HPCC. It should also be featured as an authorized application program in H.R. 1757. Global change is a critical national and international concern as reported by the Congress, the Office of Technology Assessment, and the National Academy of Sciences. Also, because of the enormity of the data required to conduct scientific research and the complexity of analytical systems required to support policy makers, global environmental change is clearly one of the most challenging applications for the HPCC.

Within this context, we recommend that H.R. 1757 be amended to incorporate CIESIN as an application of the principles set forth in this bill in the area of global environmental change data and information.

Interagency Coordination

One of the great deficiencies of interagency coordination efforts is the lack of ability of the coordinating entity to control the purse strings, that is, the actual program efforts of the participating agencies. Because of this lack of real power over the participating agencies, the coordination role often translates into a reporting shop, which simply collates information provided by the agencies and develops program plans which lack confidence in their linkage to realistic funding and authority. While such planning efforts are extremely important, they lack the critical resources to make them feasible as proposed.

Coordinating offices have served as a means for agency representatives to get together to discuss what they are doing in support of broader national missions. While this is important, it is far less significant in molding a truly national program in the service of goals set forth by Congress. The success of the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET) as an organizing process for the US Global Change Research Program has been remarkable. The coordinating role needs the strength of the discretionary budget authority to ensure that the needs of the cross-cutting program can be met. We believe that however responsive the participating agencies are, there are gaps in mission orientation that need special discretionary treatment to mitigate. It has been CIESIN's experience in making global change information accessible across agency missions suggests that the Committee should consider giving the OSTP real authority to mould the national program it is expected to coordinate.

Based on these observations, it is therefore recommended that consideration be given to amending Section 304 of the bill to give OSTP approval authority over the relevant budgets of the participating federal agencies, which are reported as part of the program. The agency budgets could be submitted to OSTP prior to the agency's submission to Office of Management and Budget. This is an important distinction from the current OMB cross-cut preparation in the CEES, wherein OSTP is at parity with other participating agencies. The CEES does coordinate the National Global Change Program budget cross-cut prior to review by the cognizant OMB staff. However, it remains unclear in the proposed H.R. 1757 whether such a cross-cut will be evoked, or as recommended herein, that OSTP lead the integrated program requirements and budget.

A mechanism could be specified for resolving disagreements between any participating agency and the OSTP in the same manner as is done for OMB disputes. In the alternative, consideration should be given to authorizing the appropriation of the full program budget to the OSTP, which would allocate the appropriate amounts to the participating agencies. This would increase the control and significance of the OSTP coordination role. In the legislative sense, such an authorization could be in addition to the separate agency authorizations made in other committees pursuant to their jurisdiction over the individual agencies.

Applications for Government Information

The bill provides for applications for government information. CIESIN was created with government information in mind, principally earth and human science information important to global change issues. The CIESIN mission involves federal, state, private, and international data resources. CIESIN's focus, however, is Earth and human science data and information, a complementary and narrower focus than that proposed in section 311 of the bill.

CIESIN is helping to establish and implement the Global Change Research Information Office (GCRIO) created by Congress in the Global Change Research Act of 1990, P.L. 101-606. This office has substantial responsibilities for disseminating global change data and information throughout the world. This office is a clearinghouse which requires linkage to every federal agency participating in the national global change program. The GCRIO is designed to be responsive to inquiries concerning the US research program, including the mitigation and adaptation components. The latter comprises the breadth of environmental technologies development supported by the federal government (e.g., pollution prevention, waste minimization, energy efficiencies). The GCRIO response to public and industry inquiry is an essential contribution to US competitiveness in the environmental technologies marketplace. With regard to H.R. 1757, the GCRIO, coupled with the CIESIN directory and information gateway capabilities, is a running start in the realization of the prototype "*Federal Information Locator*" described at sec. 311, part (c). We urge the Committee to take note of the CIESIN developments and to consider directing that these be considered in the prototype projects authorized in H.R. 1757.

I am pleased to report to you one of the most relevant examples of improving access to government information of which we are aware. I invite your attention to our proposal for a Large Scale Population and Environmental Analysis initiative. This would provide a qualitatively new level of access to data about population (demographics) and associated environmental factors in the United States. The data would be available both directly and most importantly, through appropriate simple analysis capabilities.

Nearly $2.7 billion is spent on the U.S. census each decade. This formidable budgetary commitment falls out of public view very quickly. However the resultant data are crucial for the study of the human interactions with the environment. As a Nation, we must find ways to fully utilize the costly data in the public service. We believe we are well along that path at CIESIN.

The foundation for an application we are now offering initial access to in our consortium is based upon the ***Explore*** (statistical tabulations) and ***Extract*** (data subsetting) software and the collection of data, including the 1940 through 1990 Public Use Microdata Samples from the U.S. Census. CIESIN has these data and applications available on-line and we are expanding to include other data (including remote sensed data) relevant to environmental analysis.

An example of the use of the ***Explore*** software is illustrated with the 1990 census 1% sample of the U.S. population. This is a data collection of about 1.3 Gigabytes (1.3 billion bytes) in size. In past years few have analyzed these data because even today, running on the fastest mainframe applications, it takes an hour or more to complete one analysis run, with associated high cost. The ***Explore*** software provides for interactive access to these data, with response times that are well under a minute. One analyst, who had been among the most skeptical, now uses it frequently and refers to it as "Nintendo© for researchers".

These improvements in accessibility and performance are possible because we currently run ***Explore*** and ***Extract*** on a loosely-coupled cluster of eight processors, using "parallelization". Our parallel configuration is itself a leading edge technology application, but we are not satisfied with that level of service. We are exploring, with colleagues at the NSF Supercomputer Center at Cornell University, the porting of ***Explore*** to a larger server, and eventually to others of the massively parallel systems at the national supercomputer centers (San Diego, Urbana-Champaign, or Pittsburgh). Similarly, we are planning for the distributed execution of ***Explore*** which should improve execution speed, bringing the application -- and hence the data -- within the technical reach and budget of research teams across the country.

H.R. 1757 seeks a balanced application of high-performance computing and high-speed networking. Within the context of population studies and demographic data development activities, we are intrigued and excited about our efforts to demonstrate the value of the advanced information infrastructure through real applications. We believe our applications place a special emphasis on short response delays in the network, as much as the requirement for sheer bandwidth. Our proposed combination of Distributed Computing Environment (DCE), Asynchronous Transfer Mode based networking, and parallelism provides key technology for breakthrough applications.

To this end, CIESIN is exploring partnerships for implementation of elements of a testbed for the national information infrastructure. We have entered discussions with several institutions dedicated to placing a nationwide, high performance distributed computing and network communications testbed on line by late calendar year 1993. It is important to note that industry participants in a testbed under consideration have expressed willingness to subsidize the deployment and operation of the demonstration infrastructure, in consonance with the public/private partnership cost-sharing objectives set forth at section 306(a).

Another very important venue in which CIESIN is developing *federal locator* and related *navigation aids* is the interagency Terrestrial Ecosystems Regional Research & Analysis (TERRA) Laboratory hosted at Fort Collins, Colorado. TERRA is a prime example of a regional research and analysis initiative which is multi-agency, requires active participation of state and local governments, as well as business, industry, academic institutions, and private land owners. TERRA is an interagency effort designed as an open, collaborative laboratory to develop and deliver tools and methodologies for the analysis of interactions among people, land, and natural resources. TERRA will only succeed if it is able to exploit a rich regional reserve of off-site collaborators. A broadband Information Highway is a crucial, enabling technology to effect this success.

CIESIN is involved in the planning and data resources development for one of TERRA's initial testbed activities which concerns the sustainability of the Rio Grande Basin. CIESIN is working with data providers from Colorado through New Mexico, cooperating with research and data centers as diverse as the Jornada Experimental Range in Las Cruces to the EROS Data Center in Sioux Falls. The need for interoperability and network services reaching these disparate data providers and collaborating researchers is crystal clear. The implementation of H.R. 1757, section 311, subsection (b)(1) is an important response to this interagency, intergovernmental need.

Toward NII Implementation

In our deliberations, we have labored over the ways in which a low-cost NII capability might be exploited to support the national interest in understanding the policy-relevant human dimensions of global environmental change. We looked at our current federal agency projects and extrapolated to the near future. What we saw was an exciting, highly productive, interactive, multimedia network service linking the intellectual centers of common study, inter-regionally, then inter-nationally.

Currently, CIESIN supports the EPA in several regional program needs, examining how future sources of environmental information, including satellite observations, can be applied to EPA programs, such as those embodied in the Chesapeake Bay Program Office; Great Lakes National Program Office; and the Mexico-US Border region, increasingly significant given the North American Free Trade Agreement, to name only a few. Under our current FY 1993 program plan, we will be developing regional environmental information systems for each of these key study areas.

The commonality among the analytic tools, geographic information systems, and data structures in each of these regions is obvious. The Great Lakes region is a much studied, bi-national, multi-ecosystem laboratory, uniquely valuable for understanding regional causes and effects of global environmental change. The Great Lakes Commission was formed by the Great Lakes Compact of 1955, and is implemented in legislation by the eight states with borders on the Lakes: Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin. The GLC is in the early stages of implementing the Great Lakes Information Network, which would link various member and observer institutions.

In this fiscal year, CIESIN, in consultation with the EPA Great Lakes National Program Office, will define and develop a Great Lakes regional environmental information system for the EPA. CIESIN will serve as the primary point of access to Great Lakes Information Network data and information for those outside of the Great Lakes region. CIESIN will work with the GLC and others to develop and host, at CIESIN, a large interdisciplinary database of data sets and related contextual information for the whole Great Lakes region, including Canada. The GLC will assist CIESIN in obtaining major policy documents from the International Joint Commission to add to the database. This will allow investigators to easily access data for any part of the region, across state and international boundaries.

The GLC has received support from Ameritech, Inc., the telecommunications regional operating company serving most of the Great Lakes states. This support is manifested as no-cost circuit connectivity to link partner

Commission organizations within the Great Lakes Information Network. This is a public/private partnership with the promise of expanding to the scale of other proposed national information infrastructure testbeds. CIESIN will be a cooperator in this initiative. We would like to see this effort be replicated in the east as we proceed with development of the regional environmental information system for the EPA Chesapeake Bay Program Office. The governments of Virginia, Maryland, Pennsylvania, and District of Columbia have a great stake in the success of this long-term program. Our vision would have, for example, Bell Atlantic, a regional operating company, qualitatively match the contribution of Ameritech in the Great Lakes and AT&T or Pacific Bell in the west.

An interlocking grid of cooperating, interoperable regional information systems would benefit the policy-making and natural resource management communities. All of the participating entities would agree to deploy the leading optical switching, optical fiber cable systems, in an effort to demonstrate scaleable, high-speed networking.

In the west, CIESIN is reviewing related regional network plans with the Presidio Consortium on Global Change. This consortium is dedicated to environmental education and is in the earliest stages of organizing and strategic planning. With membership including several University of California campuses, Stanford University, San Francisco State University, and industry partners, the Presidio group is likely to look toward expansion of the California Research & Education Network (Cal-REN) as the basis of its effort to demonstrate high speed networking. Pacific Bell is a prime industry partner in Cal-REN, which is deploying a spectrum of technologies from low-end Integrated Services Digital Network to the high-end, Asynchronous Transfer Mode environment in which CIESIN is already operating. CIESIN will continue to explore substantive demonstration project opportunities which would draw upon our collaboration with the Presidio Consortium.

These interactions are called to your attention to indicate that we are actively engaged in the public/private partnerships proposed in H.R. 1757, and to recommend that these ventures should be explicitly encouraged in the bill, to foster implementation of the necessary inter-regional infrastructure, the essential precursor to the international information infrastructure (I^3).

International Projects and Prototypes

It is our belief that the Committee should consider an additional component of the bill to foster international demonstration projects and applications development. The absence of such a specific section in the bill forfeits the opportunity to promulgate the standards, and hence capture the market for our advanced telecommunications and computing industries. History has shown that early promulgation, aggressive product improvement, and vigilant user services often result in *de facto* standards adoption.

Encouraging, through a specific project direction, the development of an international network access prototype within section 310, subsection (c) of the bill is recommended. We believe it will strengthen U.S. competitiveness in both the information technology market segment and in the value-added to the environmental engineering and research segments which would benefit from the global reach of the information infrastructure. Public/private partnerships should be fostered to this end.

Applications for Education

Teacher Information Support Network. H.R. 1757, sec. 308 authorizes applications for education. CIESIN has been conducting similar activities since 1991. CIESIN's Teacher Information Support Network (TISN) was composed of a partnership among universities and other educational institutions. Participants were Ball State University, East Tennessee State University, Saginaw Valley State University, Western Illinois University, Youngstown State University, Illinois State Board of Education, Michigan Department of Education, the North Carolina Department of Public Instruction, and middle schools in each of the 6 states represented.

The goal of the 1991 TISN efforts was to examine the effectiveness of distance learning technology in transferring information on global change issues. A three-day workshop was held with year-long follow-up activities which focused on: transferring information on fresh water issues to middle school teachers and providing middle school teachers with an understanding of how to use distance learning technology.

An important element of the TISN which is germane to the high speed networking environment is that CIESIN prepared detailed compilations of state and local legislation and environmental protection regulations, satellite and airborne imagery, other space-based measurements, and tabular data of the region under study. These data were retrieved and reformatted from national data resources within the federal agencies, and were brought to bear on regional and local problem identification, analysis, and assessment. The participating children and their teachers benefited from the substantial investment in our national data infrastructure, applying it to local environmental challenges which they must understand before they can act as informed decision makers.

Our pilot project employed domestic satellite capacity and the broadcast production studio facilities of participating academic institutions for the real-time two way audio and the one-way video broadcast. In this instance, subject matter experts from federal, state, and local governments, industry, and academia were linked in the now familiar "electronic town hall" setting. If the national high-speed network -- the information highway -- were in place, the cost of data delivery, the capacity to support real-time interactive manipulation and browsing of large scientific data (satellite imagery or in situ ground-based measurements of water quality), and the diversity of experts and remote participants, would have enabled a more comprehensive information utility, informing and impacting a larger segment of the public.

It is a mission objective of the CIESIN initiative to broaden access to and use of global change and environmental information. An important component in execution of that mission objective is the ability to bring the richness of our national data treasury to as many of our Nation's scientists, policy makers, and citizens as is technically feasible within the significant operative budgetary constraints. We believe that not only will such improved access enhance the quality of our decision making surrounding environmental management, due to an informed citizenry, but it will also serve to validate the investment in our collection and data processing infrastructure -- bringing it well beyond the research community to its full, and possibly noblest use, in the education of our fellow Americans.

Windows on Global Change. CIESIN also has a program called Windows on Global Change. It provides a set of multimedia tools in a learning environment. The tools were developed through a collaborative effort between CIESIN and the Jet Propulsion Laboratory/California Institute of Technology. The program offers middle school students insight into global change issues by directly involving them in the scientific exploration of spacecraft and ground-based data. It is a tool to develop greater understanding of the scientific method, while exploiting mathematics and science skills. It provides teachers and students with an interactive computer-based learning environment similar to ones currently used in global change research -- real problems, real data, real analysis tools.

We are currently evaluating the benefits of moving beyond the prototype toward full development of the Windows on Global Change learning environment. We view the tool as a window which can be tailored to local, regional, and national environmental priorities -- extremely powerful when linked with a broadband network which can support real-time delivery of data, compressed full-motion video, imagery, and other large scale data sets. Our development thus far has been directed toward an offering which has on-board communications software utilities allowing such a "port" to the information highway.

We are exploring a partnership with textbook publishers, including McGraw-Hill, Inc., to examine how our Windows learning environment can be distributed on a regional or national basis, enabling each and every school system to draw from our national data centers and information clearinghouses to customize curriculum and classroom presentations for their most urgent local environmental quality and management issues: for example, contamination of the Oglala Aquifer, drinking water quality in New York City, water distribution in the Rio Grande Valley, or the impact of non-point source pollution in the Everglades and Lake Okeechobee water basin. Each of these important human dimensions of global change demand different data resources, addressing the local and regional area of coverage. This could mean Landsat satellite images, NOAA radiometric data, USGS aquifer recharge rate data, or EPA *Storage and Retrieval of U.S. Waterways Parametric Data* (STORET) water quality data to name only a few. The issue seizes the public interest, and the relevant science captures the child's imagination and attention, when a global scale issue can be presented as a force acting in their own back yard. The information highway, utilized in applications such as CIESIN's Windows on Global Change, holds the promise of making our investment in science relevant to decision making, our behavior within the changing environment more reasoned, and the public willingness to act on policy development and implementation more likely.

Finally, within the education applications area there must be consideration given to the benefits of "collaboratory" development. High capacity networks, coupled with high-definition interactive video media, can support a wealth of scientific collaboration hitherto unseen. This can bring into the research fold many developing world collaborators who cannot otherwise afford the full array of research and analysis tools and resources we have at our disposal. Their intellectual capital, coupled with our resource base, can support the capacity development necessary to enable sustainable development and engineering of projects in the developing (e.g., G77 nations) and redeveloping (e.g., CIS, Eastern Europe) world.

We believe the CIESIN initiative has been a strong supporter and implementer of the education element of H.R. 1757. We urge the Committee to consider the value of Windows on Global Change as an investment in a flexible portal for the K-12 access to the Information Highway.

Applications for Health Care

CIESIN has been actively engaged with several key public health assessment organizations, including the Agency for Toxic Substances and Disease Registry, and the United Nations World Health Organization.

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency created by Superfund legislation in 1980. ATSDR's mission is to prevent or mitigate adverse human health effects resulting from environmental exposure to hazardous substances. ATSDR, the US Geological Survey's EROS Data Center, and CIESIN are collaborating in the development of methods for creating site-specific databases from a wide range of existing data sources. Health assessments integrate disparate data sources, including basic environmental information such as topography, hydrogeology, analytical data on contaminant concentration and distribution, health demographic data (including morbidity and mortality data), among many other sources. These data must be collected from a variety of sources including the EPA, site owners, operators, contractors, federal and state geological surveys, state and local environmental and health agencies. Our initial demonstration project illustrated how the public health assessment process could be facilitated through the integration of physical and human science data resources. We believe this success can be extended, at great savings to the taxpayer, if these resources could be rendered readily accessible through a ubiquitous national information infrastructure, exploiting navigation aids, such as the CIESIN distributed directory and information gateway.

We are under-utilizing a great national resource. It is our experience that enabling local and state public health professionals to reach the valuable data resources, such as those captured in our demonstration project, could enhance the cost-effectiveness and timeliness of public health assessment. Today, it is the rare exception, that such data resources are available.

The work of ATSDR in health assessments related to our Superfund National Priorities List will be replicated globally, for example, as the CIS and Eastern Europe begin the daunting task of cleaning up after decades of environmental abuse. Having the network information infrastructure will enable US companies and research institutions to exploit our investment in collection, and remotely retrieve, integrate, and manipulate these data to support environmental restoration activities with our international partners, offering improved capabilities in an emergent, yet highly competitive environmental clean-up market.

For the UN World Health Organization (WHO), CIESIN is establishing mechanisms to access WHO-approved data and information resources, including the WHO Mortality Database. This will enable Internet access to previously unavailable global health data sets.

Applications for Environment and Natural Resources

We note that the current legislation does not provide a section specifically dedicated to support of global environmental change and natural resources applications. We, therefore, recommend that the Committee expand the authorization to include global environmental change, environmental monitoring, natural resources management, and restoration applications.

Clearly, much of what my testimony reflects here today falls within the global environmental change domain. However, there is significant interplay between global change and the broader environmental monitoring, natural resources management, and restoration activities. We see this in the construct of ecosystems-based monitoring and management which has been embraced by the Secretary of the Interior in his recent efforts at resolving conflicts under his jurisdiction. His actions represent a broadening of the playing field on which land-use decisions are made. This broadening of stakeholder participation drives a new information imperative. This new imperative will require substantially improved information integration among parties, to enable comprehensive assessment. Federal, state, and local governments, non-governmental organizations, universities, business and industry, public and private land owners alike, each bring to the table a legacy of data and information undergirding their position. The challenge is to invite their participation, recognize the rigor of their analyses, and seek a common understanding of the observations and measurements before us.

National Biological Survey. One potential instrument of a common understanding is embodied in Secretary Babbitt's move to develop and implement a National Biological Survey (NBS). This undertaking has been masked by larger issues on the national agenda, however it represents a significant undertaking in the scientific and information management communities. Meaningful methodologies for capturing, storing, manipulating, and interpreting data on the biodiversity of our planet are not well-developed. Certainly, we have advanced much further in our ability to exploit geographic information systems, image analysis techniques, and models in the service of geology, or oceanography, than we have in the biological sciences. The dynamic nature of the biota, when contrasted with the geologic stasis, gives pause to those who will support the US Fish & Wildlife Service in building the NBS.

The national information infrastructure will clearly be called to task if we are to be successful in capturing, distributing, and integrating the vast quantities of data necessary to populate a national biological survey data base. We submit that the storehouses of data on biodiversity may be as diffuse and disparate as are the vast socio-economic data resources which CIESIN is today harnessing for the global change community.

Green GDP & Environmental Statistics. Another national priority which we believe reinforces our recommendation is President Clinton's recently announced direction to the Bureau of Economic Analysis, Department of Commerce. The Bureau has been tasked to develop national income account monitoring procedures which account for environmental degradation and the cost of pollution. The goal is a "Green Gross Domestic Product" which reflects a more accurate representation of the costs associated with our development, incorporating changes in the natural environment into the calculations of national income and wealth.

While the Bureau of Economic Analysis will be toiling with the "Green GDP", the planned Bureau of Environmental Statistics of the EPA will likely be developing in a parallel effort to foster a comprehensive set of environmental indicators for assessment of our national environmental quality and trends. Both the Green GDP and environmental statistics thrusts bring with them a major demand for ingestion of both large data sets and thousands of disparate, dissimilar data resources from local, state, regional, industrial, and academic research sources -- nationwide. Only a comprehensive information infrastructure can sustain the demands which these new national analytic capabilities will generate. Cognizant of these developments, CIESIN is working with the EPA Office of Information Resources Management in implementing a T-3 (45 megabit per second) circuit connecting the CIESIN computing facility with the EPA Bay City Supercomputer Center. We anticipate that in the near future this facility will have a substantive role in support of the environmental statistics bureau, should one be enacted into law.

International Environmental Policy. A different thrust area is the substantive international environmental treaty development, negotiation, monitoring and compliance responsibilities we as a Nation must uphold. These range in scope from the Convention on Biological Diversity and Climate Change Treaties presented to the UN Conference on Environment and Development last year, the side agreements to the North American Free Trade Agreement before us, and an array of agreements and protocols which form the challenge before the State Department's Office of Global Affairs, the President's Office of Environmental Policy, and, indeed, the United States Congress. Increasingly, the role of the United Nations will be germane. Similarly, the future may very well demand increased understanding of the quantitative elements of debt for development swaps, defining an additional international environmental intelligence gathering and analysis capability.

The ability to access and manipulate data from national and international, governmental, and non-governmental sources has become an essential capability. This demand underscores the need for an international Earth and human science network capable of serving the policy community.

Applications for Libraries

The bill provides for applications for digital libraries in section 310. CIESIN is such a library and has goals consistent with this section of the bill. We have developed successful capability to access and use "networked databases distributed around the Nation and around the world." The direction to NASA to develop databases of software and remote-sensing images to be made available over computer networks is most consistent with CIESIN's mission to serve as a gateway to the NASA Earth Observing System Data & Information System (EOSDIS). We welcome this specific direction to NASA.

CIESIN has been developing and deploying several technologies which are in direct support of the library services community. These include a distributed electronic directory which enables access to many information centers, and their resident information servers, in a seamless interactive session with users. In this way, users can navigate in an easy to use process, across the vast installed base of computers and data bases linked with the Internet worldwide.

Using the CIESIN gateway, important national data centers within NASA, DoE, USGS, and NOAA are accessible in a common format and user setting. Data remain under the control and quality assurance of the scientific data management system of origin, however it can be accessed, and used, with simple, flexible navigation tools. CIESIN has this directory operational today at several evaluation sites. Temporarily referred to as GREENpages, it is a global environmental metadata (describing the source, lineage, and characteristics of data) directory system which is interoperable with the USGCRP Global Change Master Directory, and a growing base of wide area information servers, in the national and university library systems. The CIESIN GREENpages has been provided to the federal Interagency Working Group on Data Management for Global Change, a CEES advisory body, for long-term evaluation and use.

CIESIN Directory Services are enabling a single view into a national resource base of Earth and human science data and information. As a companion to the directory, we have created an Information Gateway to assist in "resource discovery" on the Internet. Together, the directory and gateway are fundamental tools necessary to enable search, discovery, and retrieval of data and information resources available through the world-wide Internet.

Conclusions

H.R. 1757 is a welcome and needed addition to the federal efforts to create a functioning and contributing high performance computing and communications network. It is complementary to the actions of Congress in creating the HPCC and the CIESIN initiative. The bill is the next logical step in the creating an information highway and consideration should be given to incorporating the congressional CIESIN initiative as a consistent and supporting program within the framework of this watershed legislation.

The challenge for us is to make effective use of the rapidly improving data networking capabilities -- not merely as they will exist at decade's end -- but in the meantime. Indeed, the problem we confront may be what to do before the doctor comes, that is, over the period when the data highways of the future are only partially built and connection to the user workplace are the exception rather than the rule. This last mile connectivity remains a vexing problem, whether it is connectivity at any speed in the developing world, or connection at the speed of light here at home.

The bill authorizes different agency heads to take the lead in specified application areas. In addition, sums are appropriated to that agency head to carry out the mission assignment, which may involve other agencies. In order to coordinate a truly national program, the agency assigned the lead role should be expressly given the latitude to transfer funding to other agencies which have ongoing programs that could be supplemented to achieve the goals specified. This would recognize the cooperative nature of the program and the existing efforts involving the substantive applications which are authorized. It would be a means to avoid duplication of effort and to build upon work that is ongoing at other agencies, making best use of the investment to date.

We respectfully encourage the Subcommittee to recognize the congressional initiative of CIESIN as a project, prototype, and application which should be supported in the authorization.

Thank you for this opportunity to provide testimony on this important legislation.

COMMENTS ON H.R. 1757
"HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993"

Provided to the

Committee on Science, Space, and Technology
U. S. House of Representatives

May 6, 1993

By

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COMMENTS ON THE "HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993" (H.R. 1757)

SUBMITTED: MAY 6, 1993
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Mr. Chairman and members of the Subcommittee on Science of the Committee on Science, Space, and Technology of the United States House of Representatives:

Thank you for this opportunity to comment on H.R. 1757.

As the largest society of professional educators working with technology in American education, we are pleased to see this Congress consider legislation which will support the development, acquisition, and use of technology in schools across America.

The Sponsors of H.R. 1757 are to be commended for their leadership and foresight in recognizing the needs of education for --

- Instructional and administrative computing on high performance computing systems;
- Access to distance learning providers, collaborative learning experiences, high performance computing systems, and information sources over telecommunications networks; and
- Innovative applications of computing and networking technologies to make technology-enhanced curriculum, instruction, and administrative support resources and services available to all students.

These needs are generally addressed in this Administration's plans for a National Information Infrastructure (NII), the High-Performance Computing and Communications Program (HPCC), and the Information Infrastructure Technology and Applications programs (IITA) which Dr. Gibbons mentioned in his testimony on April 27, 1993. Hopefully, the details of these programs will include a comprehensive set of specific provisions -- such as those contained in H.R. 1757 -- to help develop and sustain an effective **Educational Technology Infrastructure** that will ensure the benefits of this technology to all children in America.

As a professional education society, we believe that:

- **Technology** as a tool in the learning process **is essential** to the development and maintenance of a technologically literate citizenry and internationally competitive workforce;

- Technology-based curriculum, instruction, and administrative support materials and services are needed and can be used for the **systemic improvement** of all aspects of **education**; and that

- The acquisition and use of technology in education throughout the United States has been inhibited by the absence of Federal leadership, the inability of many State and local education agencies to invest in and support the needed technologies, and the limited availability of appropriate technology-based curriculum, instruction, and administrative support materials and services in the educational marketplace.

The potential of effective learning technologies has increased dramatically over the last decade. Learning technologies have progressed from --

- simple didactic exposition (i.e., the traditional lecture classroom), to the

- technology-enhanced traditional classroom (e.g., with Televised instruction); to the

- computer-assisted instruction environment (i.e., individualized instruction with branched or sequential learning programs); to the present-day

- interactive, multi-media classroom where random access learning from an incredible variety of in-school and external information sources makes it possible for each student (or student group) to have unique learning experiences tailored to their specific learning needs and interests at the time of the learning activity.

At each stage of this progression, there was an exponential increase in the potential of technology to help educators provide better educational opportunities for children. Unfortunately, great diversity in the quantity and quality of student access to these modern learning technologies has also developed between schools and, in fact, among classrooms in the same schools throughout the United States. And, Federal leadership and funding is needed to ensure availability and access to modern learning technologies for all students.

The Federal government must develop and support a comprehensive educational technology infrastructure, if schools are to derive maximum benefit from the development of a National Information Infrastructure.

To obtain systemic improvement in education and ensure equity and access to modern learning technologies for all students throughout the United States, we recommend that the Congress develop and provide continuing support for a **comprehensive education technology infrastructure** which includes --

A. A high level Office of Educational Technology within the Executive Branch (i.e., at NSF or in the Department of Education) to provide national leadership on education technology issues, to coordinate technology for education initiatives among the various agencies of government, and to administer generic federal technology for education programs;

B. Grants for States to support their technology for education planning and for the poorest school districts to enable them to acquire and maintain technologies for education; and long term, low interest technology loans to support the acquisition of needed technologies by all schools through the "Connie Lee" program;

C. A national educational technology information dissemination repository and electronic network;

D. Regional technical assistance consortia to support technology using educators;

E. State-wide technology training programs for educators;

F. Technology for education product development grants (e.g., Star Schools) and partnerships to support the continuing development of technology-based curriculum, instruction, and administrative support materials and services **by business led consortia** of local/state education agencies, universities, regional labs and centers, and other individuals and groups; and

G. Federal support for research and development efforts which identify and plan educational needs for high performance computing and telecommunications networks, develop educational applications of promising new technologies, and conduct/publish results of effectiveness studies and technology in school surveys for use by decision-makers.

In order to develop this needed comprehensive educational technology infrastructure, it is recommended that Section 308 of H.R. 1757 be revised to include these suggested components.

It is estimated that approximately $350 million will be needed to fully fund the development of an effective educational technology infrastructure. A suggested allocation of these funds would be as follows:

A.	Leadership for Technology in Education	- (2%)
B.	State Planning and School Technology Acquisition Support	- (50%)
C.	National Repository and Electronic Dissemination Network	- (3%)
D.	Regional Technical Assistance Consortia	- (5%)
E.	Technology for Education Training	- (15%)
F.	Technology for Education Product Development Grants and Business Partnerships	- (20%)
G.	R&D on High Performance Computing and Telecommunications Networks; Advanced Technology Applications; Effectiveness Assessments; and State-of-the-Art Surveys	- (5%)

STATEMENT OF

COALITION FOR PATENT INFORMATION DISSEMINATION

ON H.R. 1757

THE "HIGH PERFORMANCE COMPUTING AND HIGH SPEED
NETWORKING APPLICATIONS ACT OF 1993"

SUBMITTED TO THE SUBCOMMITTEE ON SCIENCE
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

MAY 6, 1993

STATEMENT OF
COALITION FOR PATENT INFORMATION DISSEMINATION

ON H.R. 1757

THE "HIGH PERFORMANCE COMPUTING AND HIGH SPEED NETWORKING APPLICATIONS ACT OF 1993"

SUBMITTED TO THE SUBCOMMITTEE ON SCIENCE
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

MAY 6, 1993

Mr. Chairman:

Thank you for the opportunity to submit this statement for the record in the Hearings on H.R. 1757. The Coalition for Patent Information Dissemination consists of database publishers, CD-ROM publishers, and online services that disseminate patent information to hundreds of thousands of engineers, chemists, scientists, researchers, patent attorneys, and patent searchers.

The United States electronic information services industry leads the world. Patent information is an important segment of this industry. For over ten years, Coalition members and other companies in the field, have been building digital libraries of patents. Until recently, these digital libraries contained text only. Now, digitized images -- consisting of patent drawings -- are being added. Patent images are already available on CD-ROMs, and will soon be available online.

We have been very impressed, Mr. Chairman, with the thoughtfulness you have given to the relative roles of the government and the private sector in the program envisaged by this legislation. This is well illustrated by amended Section 102(d)(1) which provides that "the test bed networks shall not be used to provide services that could otherwise be provided satisfactorily using privately operated commercial networks." This principle is one we believe to be sound, i.e., that the government should not provide services where private sector services are already available. As you observed at the April 27, 1993, Hearing, the trend at NSF is in accordance with this principle. So, although the principle is widely shared and is, we believe, implicit in every part of H.R. 1757, we would like to emphasize its particular importance to "Section 311. Applications for Government Information."

OSTP Director Gibbons, in his April 27, 1993, testimony, provided further clarification of the applicability of the principle to Section 311. He indicated that much government information has been developed which isn't made available, and that one of the objectives was to make such information more readily available. We agree with and support this objective. However, where information is already readily available from the private sector, and competition exists, government should not offer a new service. Patent information is an example of such a case.

The U.S. Patent and Trademark Offices' (PTO) patent information dissemination program has been a major government information dissemination success story. For over ten years, PTO and private sector electronic information services firms have engaged in a productive partnership under which PTO has made patent text -- and more recently images -- available on magnetic tapes and cartridges weekly for a price based on the cost of dissemination. From these, private sector firms have created a diversity of products and services including specialized patent databases, patent databases of text and images on CD-ROMs, and online search and retrieval of a variety of patent databases. Although these online digital libraries have been primarily text-based, all of them are now beginning to add image retrieval, which will enable users to view patent drawings.

We should emphasize that there is competition in each of the product and service areas. For example, in each case, at least two or more competing companies provide full-text search of patents, produce text and images on CD-ROMs; publish specialized databases for searching patent technology; or provide online search of specialized patent databases.

We are not suggesting patent information sources should not be connected to Internet. Indeed, starting in 1991, private sector online services have been connected and are now accessible via the Internet. Thus, anyone on the Internet can have access to multiple patent databases via private sector services.

The importance of the 102(d)(1) principle can be illustrated by the impacts a competing government-provided online patent service would have on the private sector.

1. It would have the same impact on the U.S. electronic information services industry that the subsidized European Airbus has had on McDonnell Douglas. It will erode revenues, and reduce the private sector ability to invest in information technology advances. The government would thereby be playing the role of decelerator. We believe, in agreement with Dr. Gibbons, that the government's proper role is to be a catalyst.

2. A PTO service would threaten the world-leading position of the U.S. electronic information services industry patent information segment.

3. Providing Internet access to the PTO Automated Patent System would threaten the security and secrecy of the thousands of patent applications that will soon be in electronic form. Because of the tremendous value of the secret technological information in pending applications, there would be huge incentives on the part of foreign intelligence services, or competitors, to penetrate the security of the system.

4. A PTO service would amount to decommercialization of electronic patent information services. We believe government's role should be the opposite, i.e, to encourage continuing commercialization.

5. You should be aware of the context of these statements. The PTO already provides highly targeted online search services in its public search room in Crystal City, and in the Patent and Trademark Depository Libraries. The Coalition does not oppose these services so long as access is controlled and so long as user fees based on the cost of dissemination are charged. We should note, however, that where student or individual occasional use is concerned, private sector online services have special services for students, and after-hours use for all users, at prices ranging from one-tenth to one-third of the PTO user fees (which are themselves substantially below the actual cost of dissemination).

Mr. Chairman, we believe these reasons strongly support the principle of Section 102(d)(1), and illustrate why that principle is so important for the U.S. competitive position. Further, they are consistent with President Clinton's and Vice President Gore's February 22, 1993, Technology Initiative in which they discussed promoting government information dissemination "while encouraging the growth of the information industry."

Although our major concern is that Section 311 not be used to injure the U.S. competitive position in electronic information services, we do have brief comments on another part of H.R. 1757.

Copyright

Creation of digital libraries is the fourth application in H.R. 1757. Their creation would be facilitated by Section 310(b)(2) which authorizes the "development of high-speed, highly accurate systems for converting printed text, page images, graphics, and photographic images into electronic form(;)." This language ignores copyright and capsulizes in just twenty words the ultimate nightmare of authors, photographers, and publishers as they contemplate high-speed networks. Although it could be argued it is merely referring to development of systems, the language implies that every work converted is in the public domain and does not recognize the need to obtain the permission of copyright holders for material still under copyright. Conversion does not occur in a legal vacuum. Indeed, once ten or more copyrighted works with a total retail value of $2500 have been converted, a felony offense may have been committed, unless permission has been obtained from the copyright holder. This issue needs to be considered in the development stage, since the systems should have a capability for electronic "tagging" of copyrighted works as part of conversion. One possibility is to amend the subsection to read as follows:

> "(2) development of high-speed, highly accurate systems for converting printed text, page images, graphics, and photographic images into electronic form. Such systems shall include capabilities for electronically identifying copyrighted works and for electronically indicating that permission for conversion has been granted for copyrighted works;" (new language underlined)

In addition to this change, consideration should be given to adding development of copyright protection and management technologies as a project under Section 310(b). If such applications are not developed in parallel with the other projects, the value of digital libraries could be substantially reduced because of the resulting omission of copyrighted material.

One more suggested amendment grows out of the fact that the means for ensuring the security and privacy of transmissions over the Internet are similar to the means that could be used for protection and management of copyrighted works. Encryption can be used to make sure that only an authorized reader has access to a message or to a copyrighted work; a digital signature can be used to ensure the authenticity and integrity of a message or a copyrighted work; and object oriented programming can be used to create encapsulated software objects that serve as virtual envelopes and provide accounting for access and use, and for payment of royalties. Publishers and information providers have the responsibility for selecting the means they will use to both protect and account for the use of their copyrighted works in high-speed networks. But the national information infrastructure should include features and functionalities that enable and facilitate the operation of copyright protection and management applications. Thus, we respectfully request that consideration be given to amending Section 307(b) to read as follows:

> "NETWORK SECURITY AND PRIVACY.-- The Plan shall specify research programs needed to create means to ensure the security and privacy of transmissions over the Internet and the integrity of, and accountability for, digital information accessed via the Internet, so as to enable copyright protection and management applications." (new material underlined)"

We thank you, Mr. Chairman, for this opportunity to present our views to you and the Subcommittee. We would be pleased to respond to any questions you may have, or to assist you in any way we can to make the vision of H.R. 1757 a reality.

Further details on electronic patent information dissemination, on the public/private partnership that has created this successful program, and on the policy considerations of such a program, are available in two Coalition reports, copies of which have been submitted to the Subcommittee. These are: *Electronic Dissemination of U.S. Patent Information: An Information Dissemination Success Story*; and, *Competition, Jobs, and Information Policy: The Case for Private Sector Patent Information Dissemination*.

Coalition Members: BRS Information Technologies; Derwent, Inc.; DIALOG Information Services; IFI/Plenum Data Corporation; Mead Data Central and its LEXPAT Service; ORBIT Search Service; Rapid Patent, Research Publications International; and, West Publishing Company.

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May 20, 1993

Honorable Rick Boucher, Chairman
Subcommittee on Science
Committee on Science, Space and Technology
United States House of Representatives
Washington, D.C. 20515

Re: H.R. 1757, the High Performance
Computing and High Speed Networking
Applications Act of 1993

Dear Mr. Chairman:

ABCD has followed with great interest and enthusiasm the Subcommittee's focus on the future of computing and computer networks, both near and long-term. As the development of what will eventually become the National Information Infrastructure continues at a rapid pace, it is vitally important that the Congress stay abreast of developments and to help foster and guide the NII, so that its benefits live up to expectations.

Mr. Chairman, ABCD strongly supports passage of H.R. 1757 as a significant step in the continuing development of the NII. As a trade association composed of more than 2,700 computer hardware manufacturers, software publishers, national franchisers and ownership groups, as well as independent dealers, ABCD appreciates this opportunity to submit its views on H.R. 1757 to the Subcommittee. To give you more of an overview of the scope of our members, ABCD members had more than $43 billion of the $60 billion in combined U.S. microcomputer sales for 1990, according to a recent survey conducted on our behalf by InfoCorp.

The three hearings focusing on H.R. 1757 by the Subcommittee have produced a wealth of information from a wide variety of perspectives. While many of the witnesses had constructive suggestions for possible changes in H.R. 1757, there was general agreement on the need for this legislation and its desirability as a logical extension of the HPCC Act passed by the Congress in 1991.

ABCD believes the H.R. 1757 appropriately sets forth the roles of government and the private sector. We concur in the notion that government should promote R&D, help coordinate standards development, and provide assistance to users to get on the network. The private sector, on the other hand, should be left the task of actually building and operating the network. While it will always be difficult to predict with any certainty just what portion or portions of the network will be built by whom, it is not difficult to predict that, as technology develops, the private sector will respond to new demands and create the market for services that consumers deem desirable. Given appropriate incentive, we have no doubt that any number of service providers will come forward. It will be neither necessary nor desirable for the government to get into the business of building or operating networks in competition with the private sector. During the hearings, Mr. Chairman, you made your support for this proposition abundantly clear. In that regard, ABCD would support any amendments the Subcommittee thinks necessary to make sure that H.R. 1757 clearly reflects that separation of functions.

As a related matter, we would also note that several Subcommittee witnesses made reference to various regulatory and other legal barriers that continue to serve as impediments to full participation by the private sector in network deployment. While this issue is not addressed in H.R. 1757, and while we are aware that

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various pieces of legislation addressing these barriers, such as the MFJ restrictions, are pending in other committees, ABCD fully supports the lifting or removal of such restrictions whenever possible. The reason for our support is simple: the more competition in any market, the better. Particularly in the development of the NII, where capital costs will continue to be exceedingly high, the user public can only benefit from increased participants in the market. Oversight and competitive safeguards will undoubtedly play a role when industries collide. Nevertheless, heretofore separate technologies are being rapidly pushed together, and the nation should not impede spectacular advances because of restrictions or artificial barriers.

Mr. Chairman, another area addressed by several witnesses during the hearings is that of governmental process and the opportunity for public input in the development of that process. We feel that H.R. 1757's requirement of the development and implementation of a plan by FCCSET and certain designated agencies, is a solid step in the right direction. We also applaud the expansion of the High-Performance Computing and Applications Advisory Committee and, we should add, sincerely hope that it will finally be appointed and begin to function. Mr. Donald Lindberg, in his May 11th appearance before the Subcommittee, certainly felt a pressing need for the advisory committee, and we completely concur in his desire to have the President name its members. While we think that H.R. 1757 would add more opportunity for public input than currently exists, we would urge the Subcommittee to contemplate additional provisions, which would more specifically contemplate public participation in the decision-making process at the various federal agencies and FCCSET as well. Public input and participation need not mean added complexity and delay; it does, however, hold out the potential for helpful information and expertise.

Mr. Chairman, ABCD's interest in the computer network of the future is both intense and obvious. The better the network, the more services offered, the more productive the user - all add up to our industry continuing to thrive. Over the last decade, one would be hard-pressed to point to a better consumer success story. As capacity and power have grown over the years, prices have continued to fall. Continually increasing productivity is the key, and the industry's success on that point speaks for itself.

ABCD is confident that the Subcommittee's continuing attention to the future of computing - as exemplified by H.R. 1757 - will be a major reason that our nation stays on the right track. While the role of government is rightfully limited, that role is nonetheless very important in the promotion and development of technology which will eventually be deployed to the benefit of us all. We also see the private sector as ready and able to take up the challenge of the physical creation of the NII, and desirous of working hand-in-hand with government to make sure it happens. Mr. Chairman, H.R. 1757 is a good step along this road, and ABCD again expresses its gratitude for your leadership and foresight. As the Subcommittee's hearings demonstrate, there are literally dozens of groups - both large and small - intensely interested in the NII. We have reviewed numerous policy papers produced by such groups as the Computer Systems Policy Project and the Regional Bell Operating Companies, and find ourselves in accord with their general principles.

We would respectfully request that this letter be made part of the Subcommittee's hearing record on H.R. 1757.

Please let us know if you have any questions or need additional information.

Sincerely yours,

Richard Stopa

Richard L. Stopa
Chairman, Board of Directors

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